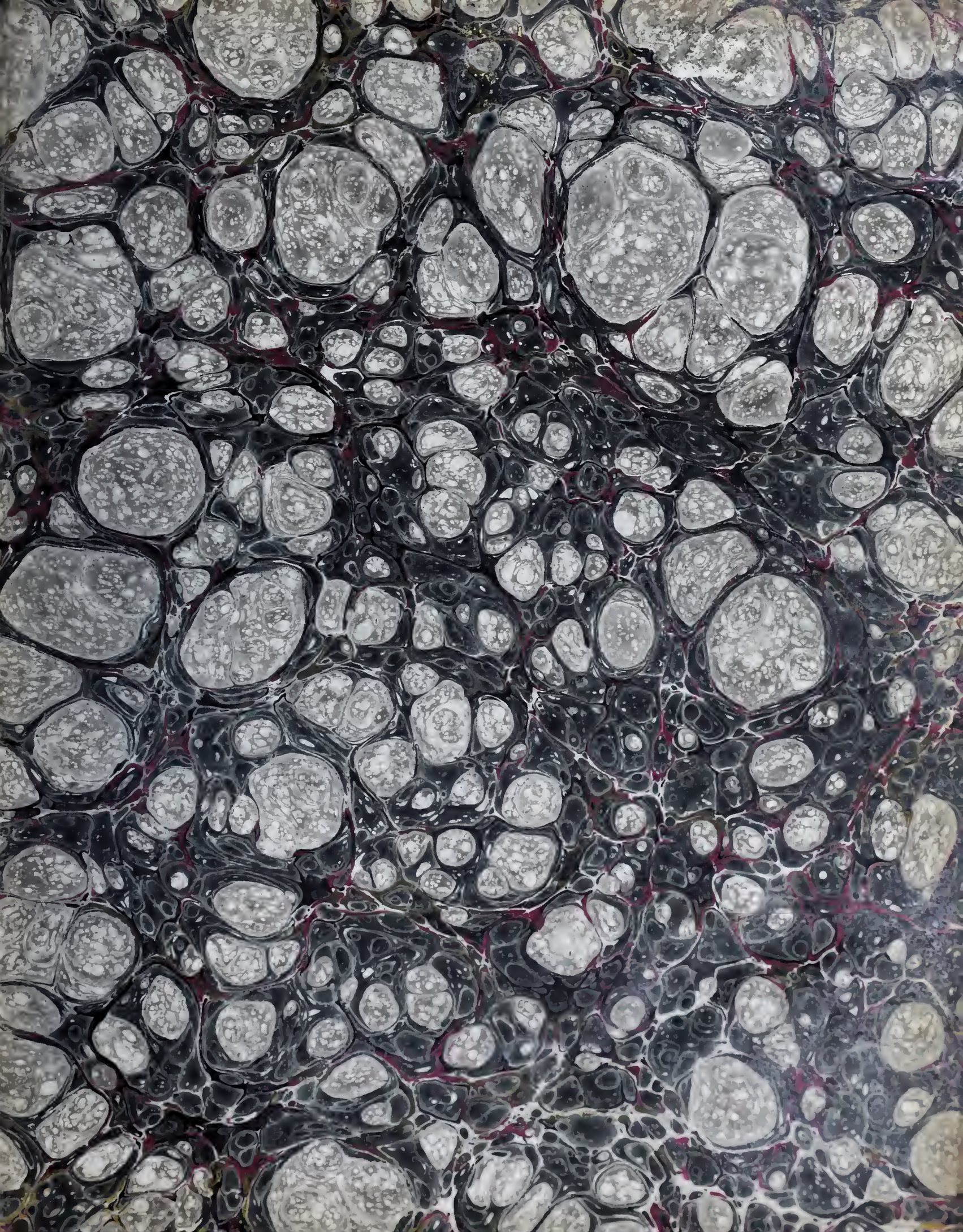
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ENCYCLOPÆDIA BRITANNICA.

M I C.

Micro-scope.

MICROSCOPE, an optical instrument, consisting of lenses, or mirrors, by means of which small objects appear larger than they do to the naked eye. *Single* microscopes consist of a single lens or mirror; or if more lenses or mirrors be made use of, they only serve to throw light upon the object, but do not contribute to enlarge the image of it. *Double* or *compound* microscopes are those in which the image of an object is composed by means of more lenses or mirrors than one.

For the principles on which the construction of microscopes depends, see OPTICS. In the present article, it is intended to describe the finished instrument, with all its varied apparatus, according to the latest improvements; and to illustrate by proper details its uses and importance.

I. *Of* SINGLE *Microscopes.*

THE famous microscopes made use of by Mr Leeuwenhoeck, were all, as Mr Baker assures us, of the single kind, and the construction of them was the most simple possible; each consisting only of a single lens set between two plates of silver, perforated with a small hole, with a moveable pin before it to place the object on and adjust it to the eye of the beholder. He informs us also, that *lenses* only, and not *globules*, were used in every one of these microscopes.

Plate CCCXXXVII. Fig. 1.

1. The single microscope now most generally known and used is that called *Wilson's Pocket Microscope*. The body is made of brass, ivory, or silver, and is represented by AA, BB. CC is a long fine threaded male screw that turns into the body of the microscope; D a convex glass at the end of the screw. Two concave round pieces of thin brass, with holes of different diameters in the middle of them, are placed to cover the above-mentioned glass, and thereby diminish the aperture when the greatest magnifiers are employed. EE, three thin plates of brass within the body of the microscope; one of which is bent semicircularly in the middle, so as to form an arched cavity for the reception of a tube of glass, the use of the other two being to receive and hold the sliders between them. F, a piece of wood or ivory, arched in the manner of the semicircular plate, and cemented to it. G, the other end of the body of the microscope, where a [illegible] low female screw is adapted to receive the different magnifiers. H is a spiral spring of steel, between

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M I C

Micro-scope.

the end G and the plates of brass, intended to keep the plates in a right position and counteract the long screw CC. I is a small turned handle, for the better holding of the instrument, to screw on or off at pleasure.

To this microscope belong six or seven magnifying glasses: six of them are set in silver, brass, or ivory, as in the figure K; and marked 1, 2, 3, 4, 5, 6, the lowest numbers being the greatest magnifiers. L is the seventh magnifier, set in the manner of a little barrel, to be held in the hand for the viewing of any larger object. M is a flat slip of ivory, called a *slider*, with four round holes through it, wherein to place objects between two pieces of glass or Muscovy tale, as they appear at *d d d d*. Six such sliders, and one of brass, are usually sold with this microscope, some with objects placed in them, and others empty for viewing any thing that may offer: but whoever pleases to make a collection, may have as many as he desires. The brass slider is to confine any small object, that it may be viewed without crushing or destroying it. N is a tube of glass contrived to confine living objects, such as frogs, fishes, &c. in order to discover the circulation of the blood. All these are contained in a little neat box of fish-skin or mahogany, very convenient for carrying in the pocket.

When an object is to be viewed, thrust the ivory slider, in which the said object is placed, between the two flat brass plates EE: observing always to put that side of the slider where the brass rings are farthest from the eye. Then screw on the magnifying glass you intend to use, at the end of the instrument G; and looking through it against the light, turn the long screw CC, till your object be brought to suit your eye; which will be known by its appearing perfectly distinct and clear. It is most proper to look at it first through a magnifier that can show the whole at once, and afterwards to inspect the several parts more particularly with one of the greatest magnifiers; for thus you will gain a true idea of the whole, and of all its parts. And though the greatest magnifiers can show but a minute portion of any object at once, such as the claw of a flea, the horn of a louse, or the like; yet by gently moving the slider which contains the object, the eye may gradually examine it all over.

An object must be brought very near the glasses when the greatest magnifiers are made use of, be careful not to scratch them by rubbing the slider against

Microscope.

them as you move it in or out. A few turns of the screw CC will easily prevent this mischief, by giving them room enough. You may change the objects in your sliders for any others you think proper, by taking out the brass rings with the point of a penknife; the tales will then fall out, if you but turn the sliders; and after putting what you please between them, by replacing the brass rings you will fasten them as they were before. It is proper to have some sliders furnished with tales, but without any object between them, to be always in readiness for the examination of fluids, salts, sands, powders, the farina of flowers, or any other casual objects of such sort as need only be applied to the outside of the tale.

The circulation of the blood may be easiest seen in the tails or fins of fishes, in the fine membranes between a frog's toes, or best of all in the tail of a water-newt. If your object be a small fish, place it within the tube N, and spread its tail or fin along the side thereof: if a frog, choose such a one as can but just be got into your tube; and, with a pen, or small stick, expand the transparent membrane between the toes of the frog's hind foot as much as you can. When your object is so adjusted that no part of it can intercept the light from the place you intend to view, unscrew the long screw CC, and thrust your tube into the arched cavity, quite through the body of the microscope; then screw it to the true focal distance, and you will see the blood passing along its vessels with a rapid motion, and in a most surprising manner.

The third or fourth magnifiers may be used for frogs or fishes: but for the tails of water-newts, the fifth or sixth will do; because the globules of their blood are twice as large as those of frogs or fish. The first or second magnifier cannot well be employed for this purpose; because the thickness of the tube in which the object lies, will scarce admit its being brought so near as the focal distance of the magnifier.

An apparatus for the purpose of viewing opaque objects generally accompanies this microscope; and which consists of the following parts. A brass arm QR, which is screwed at Q, upon the body of the microscope at G. Into the round hole R, any of the magnifiers suitable to the object to be viewed are to be screwed; and under it, in the same ring, the concave polished silver speculum S. Through a small aperture in the body of the microscope, under the brass plates EE, is to slide the long wire with the forceps T: This wire is pointed at one of its ends; and so, that either the points or forceps may be used for the objects as may be necessary. It is easy to conceive, therefore, that the arm at R, which turns by a twofold joint at *a* and *b*, may be brought with its magnifier over the object, the light reflected upon it by the application of the speculum, and the true focus obtained by turning of the male screw CC as before directed.—As objects are sometimes not well fixed for view, either by the forceps or point, the small piece shown at V is added, and in such cases answers better: it screws over the point of T; it contains a small round piece of ivory, blackened on one side, and left white upon the other as a contrast to coloured objects, and by a small piece of watch-spring fastens down the objects upon the ivory.

Microscope.

2. *Single Microscope by reflection.* In fig. 2. A is a scroll of brass fixed upright upon a round wooden base B, or a mahogany drawer or case, so as to stand perfectly firm and steady. C is a brass screw, that passes through a hole in the upper limb of the scroll into the side of the microscope D, and screws it fast to the said scroll. E is a concave speculum set in a box of brass, which hangs in the arch G by two small screws *ff*, that screw into the opposite sides thereof. At the bottom of this arch is a pin of the same metal, exactly fitted to a hole *h* in the wooden pedestal, made for the reception of the pin. As the arch turns on this pin, and the speculum turns on the end of the arch, it may, by this twofold motion, be easily adjusted in such a manner as to reflect the light of the sun, of the sky, or of a candle, directly upwards through the microscope that is fixed perpendicularly over it; and by so doing may be made to answer many purposes of the large double reflecting microscope. The body of the microscope may also be fixed horizontally, and objects viewed in that position by any light you choose; which is an advantage the common double reflecting microscope has not. It may also be rendered further useful by means of a slip of glass; one end of which being thrust through between the plates where the sliders go, and the other extending to some distance, such objects may be placed thereon as cannot be applied in the sliders: and then, having a limb of brass that may fasten to the body of the microscope, and extend over the projecting glass a hollow ring wherein to screw the magnifiers, all sorts of subjects may be examined with great convenience, if a hole be made in the pedestal, to place the speculum exactly underneath, and thereby throw up the rays of light. The pocket-microscope, thus mounted, says Mr Baker, "is as easy and pleasant in its use; as fit for the most curious examination of the animalcules and salts in fluids, of the farine in vegetables, and of the circulation in small animals; in short, is as likely to make considerable discoveries in objects, that have some degree of transparency, as any microscope I have ever seen or heard of."

The brass scroll A is now generally made to unscrew into three parts, and pack with the microscope and apparatus into the drawer of a mahogany pocket-case, upon the lid of which the scroll is made to fix when in use.

The opaque apparatus also, as above described, is applicable this way by reflection. It only consists in turning the arm R (fig. 1.), with the magnifier over the concave speculum below (fig. 2.), or to receive the light as reflected obliquely from it: the silver speculum screwed into R will then reflect the light, which it receives from the glass speculum, strongly upon the object that is applied upon the wire T underneath.

This microscope, however, is not upon the most convenient construction, in comparison with others now made: it has been esteemed for many years past from its popular name, and recommendation by its makers. Its portability is certainly a great advantage in its favour; but in most respects it is superseded by the microscopes hereafter described.

3. *Microscope for Opaque Objects, called the Single Opaque Microscope.* This microscope remedies the inconvenience of having the dark side of an object next Fig. 3.

the

Micro-scope.

the eye, which formerly was an insurmountable objection to the making observations on opaque objects with any considerable degree of exactness or satisfaction: for, in all other contrivances commonly known, the nearness of the instrument to the object (when glasses that magnify much are used) unavoidably overshadows it so much, that its appearance is rendered obscure and indistinct. And, notwithstanding ways have been tried to point light upon an object, from the sun or a candle, by a convex glass placed on the side thereof, the rays from either can be thrown upon it in such an acute angle only, that they serve to give a confused glare, but are insufficient to afford a clear and perfect view of the object. But in this microscope, by means of a concave speculum of silver highly polished, in whose centre a magnifying lens is placed, such a strong and direct light is reflected upon the object, that it may be examined with all imaginable ease and pleasure. The several parts of this instrument, made either of brass or silver, are as follow.

Through the first side A, passes a fine screw B, the other end of which is fastened to the moveable side C. D is a nut applied to this screw, by the turning of which the two sides A and C are gradually brought together. E is a spring of steel that separates the two sides when the nut is unscrewed. F is a piece of brass, turning round in a socket, whence proceeds a small spring tube moving upon a rivet; through which tube there runs a steel wire, one end whereof terminates in a sharp point G, and the other with a pair of pliers H fastened to it. The point and pliers are to thrust into, or take up and hold, any insect or object; and either of them may be turned upwards, as best suits the purpose. I is a ring of brass, with a female screw within it, mounted on an upright piece of the same metal; which turns round on a rivet, that it may be set at a due distance when the least magnifiers are employed. This ring receives the screws of all the magnifiers. K is a concave speculum of silver, polished as bright as possible; in the centre of which is placed a double convex lens, with a proper aperture to look through it. On the back of this speculum a male screw L is made to fit the brass ring I, to screw into it at pleasure. There are four of these concave specula of different depths, adapted to four glasses of different magnifying powers, to be used as the objects to be examined may require. The greatest magnifiers have the least apertures. M is a round object-plate, one side of which is white and the other black: The intention of this is to render objects the more visible, by placing them, if black, on the white side, or, if white, on the black side. A steel spring N turns down on each side to make any object fast; and issuing from the object-plate is a hollow pipe to screw it on the needle's point G. O is a small box of brass, with a glass on each side, contrived to confine any living object, in order to examine it: this also has a pipe to screw upon the end of the needle G. P is a turned handle of wood, to screw into the instrument when it is made use of. Q, a pair of brass pliers to take up any object, or manage it with conveniency. R is a soft hair-brush for cleaning the glasses, &c. S is a small ivory box for tales, to be placed, when wanted, in the small brass box O.

When you would view any object with this microscope, screw the speculum, with the magnifier you think proper to use, into the brass ring I. Place your object, either on the needle G in the pliers H, on the object-plate M, or in the hollow brass box O, as may be most convenient; then holding up your instrument by the handle P, look against the light through the magnifying lens; and by means of the nut D, together with the motion of the needle, by managing its lower end, the object may be turned about, raised, or depressed, brought nearer the glass, or removed farther from it, till you find the true focal distance, and the light be seen strongly reflected from the speculum upon the object, by which means it will be shown in a manner surprisingly distinct and clear; and for this purpose the light of the sky or of a candle will answer very well. Transparent objects may also be viewed by this microscope; only observing, that when such come under examination, it will not always be proper to throw on them the light reflected from the speculum; for the light transmitted through them, meeting the reflected light, may together produce too great a glare. A little practice, however, will show how to regulate both lights in a proper manner.

Micro-scope.

4. *Ellis's single and Aquatic Microscope.* Fig. 4. represents a very convenient and useful microscope, contrived by Mr John Ellis, author of An Essay upon Corallines, &c. To practical botanists, observers of animalcula, &c. it possesses many advantages above those just described. It is portable, simple in its construction, expeditious, and commodious in use. K represents the box containing the whole apparatus: it is generally made of fish-skin; and on the top there is a female screw, for receiving the screw that is at the bottom of the pillar A: this is a pillar of brass, and is screwed on the top of the box. D is a brass pin which fits into the pillar; on the top of this pin is a hollow socket to receive the arm which carries the magnifiers; the pin is to be moved up and down, in order to adjust the lenses to their focal or proper distance from the object. [*N. B.* In the representations of this microscope, the pin D is delineated as passing through a socket at one side of the pillar A; whereas it is usual at present to make it pass down a hole bored through the middle of the pillar.] F, the bar which carries the magnifying lens; it fits into the socket X, which is at the top of the pin or pillar D. This arm may be moved backwards and forwards in the socket X, and sideways by the pin D; so that the magnifier, which is screwed into the ring at the end E of this bar, may be easily made to traverse over any part of the object that lies on the stage or plate B. FF is a polished silver speculum, with a magnifying lens placed at the centre thereof, which is perforated for this purpose. The silver speculum screws into the arm E, as at F. G, another speculum, with its lens, which is of a different magnifying power from the former. H, the semicircle which supports the mirror I; the pin R, affixed to the semicircle H, passes through the hole which is towards the bottom of the pillar A. B, the stage, or the plane, on which the objects are to be placed; it fits into the small dove-tailed arm which is at the upper end of the pillar DA. C, a plane glass, with a small piece of black silk stuck on it; this glass is to lay in a groove made in the stage C. M, a hollow glass to be laid occasionally on the stage in-

Fig. 4.

Microscope.

stead of the plane glass C. L, a pair of nippers. These are fixed to the stage by the pin at bottom; the steel wire of these nippers slides backwards and forwards in the socket, and this socket is moveable upwards and downwards by means of the joint, so that the position of the object may be varied at pleasure. The object may be fixed in the nippers, stuck on the point, or affixed, by a little gum-water, &c. to the ivory cylinder N, which occasionally screws to the point of the nippers.

To *use* this microscope: Take all the parts of the apparatus out of the box; then begin by screwing the pillar A to the cover thereof; pass the pin R of the semicircle which carries the mirror through the hole that is near the bottom of the pillar A; push the stage into the dove-tail at B, slide the pin into the pillar (see the *N. B.* above); then pass the bar E through the socket which is at the top of the pin D, and screw one of the magnifying lenses into the ring at F. The microscope is now ready for use: and though the enumeration of the articles may lead the reader to imagine the instrument to be of a complex nature, we can safely affirm that he will find it otherwise. The instrument has this peculiar advantage, that it is difficult to put any of the pieces in a place which is appropriated to another. Let the object be now placed either on the stage or in the nippers L, and in such manner that it may be as nearly as possible over the centre of the stage: bring the speculum F over the part you mean to observe; then throw as much light on the speculum as you can, by means of the mirror I, and the double motion of which it is capable; the light received on the speculum is reflected by it on the object. The distance of the lens F from the object is regulated by moving the pin D up and down, until a distinct view of it is obtained. The best rule is, to place the lens beyond its focal distance from the object, and then gradually to slide it down till the object appears sharp and well defined. The adjustment of the lenses to their focus, and the distribution of the light on the object, are what require the most attention: on the first the distinctness of the vision depends; the pleasure arising from a clear view of the parts under observation is due to the modification of the light. No precise rule can be given for attaining accurately these points; it is from practice alone that ready habits of obtaining these necessary properties can be acquired, and with the assistance of this no difficulty will be found.

Fig. 5.

5. A very simple and convenient microscope for botanical and other purposes, though inferior in many respects to that of Mr Ellis, was contrived by the ingenious Mr Benjamin Martin, and is represented at fig. 5. where AB represents a small arm supporting two or more magnifiers, one fixed to the upper part as at B, the other to the lower part of the arm at C; these may be used separately or combined together. The arm AB is supported by the square pillar IK, the lower end of which fits into the socket E of the foot FG; the stage DL is made to slide up and down the square pillar; H, a concave mirror for reflecting light on the object.—To *use* this microscope, place the object on the stage, reflect the light on it from the concave mirror, and regulate it to the focus, by moving the stage nearer to or farther from the lens at B. The ivory sliders pass through the stage; other objects may be fixed in the nippers MN, and then brought under the eye-glasses; or they may be laid on one of the glasses which fit the stage. The apparatus to this instrument consists of three ivory sliders; a pair of nippers; a pair of forceps; a flat glass and a concave ditto, both fitted to the stage.

Microscope.

The two last microscopes are frequently fitted up with a toothed rack and pinion, for the more ready adjustment of the glasses to their proper focus.

6. *Withering's portable Botanic Microscope.* Fig. 6. represents a small botanical microscope contrived by Dr Withering, and described by him in his *Botanical Arrangements*. It consists of three brass plates, ABC, which are parallel to each other; the wires D and E are rivetted into the upper and lower plates, which are by this means united to each other; the middle plate or stage is moveable on the aforesaid wires by two little sockets which are fixed to it. The two upper plates each contain a magnifying lens, but of different powers; one of these confines and keeps in their places the fine point F, the forceps G, and the small knife H.—To *use* this instrument, unscrew the upper lens, and take out the point, the knife, and the forceps; then screw the lens on again, place the object on the stage, and then move it up or down till you have gained a distinct view of the object, as one lens is made of a shorter focus than the other; and spare lenses of a still deeper focus may be had if required. This little microscope is the most portable of any. Its principal merit is its simplicity. Fig. 6.

7. *Botanical Lenses or Magnifiers.* The haste with which botanists, &c. have frequently occasion to view objects, renders an extempore pocket-glass indispensably necessary. The most convenient of any yet constructed, appears to be that contrived, in regard to the form of the mounting, by Mr Benjamin Martin; and is what he called a *Hand Megalascope*, because it is well adapted for viewing all the larger sort of small objects universally, and by only three lenses it has seven different magnifying powers.

Fig. 7. represents the case with the three frames and lenses, which are usually of 1, $1\frac{1}{2}$, and 2 inches focus: they all turn over each other, and shut into the case, and are turned out at pleasure. Fig. 7.

The three lenses singly, afford three magnifying powers; and by combining two and two, we make three more: for *d* with *e* makes one, *d* with *f* another, and *e* with *f* a third; which, with the three singly, make six; and lastly, all three combined together make another; so that upon the whole, there are seven powers of magnifying with these glasses only.

When the three lenses are combined, it is better to turn them in, and look through them by the small apertures in the sides of the case. The eye in this case is excluded from extra light; the aberration of the superfluous rays through the glasses is cut off; and the eye coincides more exactly with the common axes of the lenses.

Plate CCCXXXVIII.

A very useful and easy kind of microscope (described by Joblot, and which has been long in use), adapted chiefly for viewing, and confining at the same time, any living insects, small animals, &c. is shown at fig. 8. where A represents a glass tube, about $1\frac{1}{4}$ inch diameter, and 2 inches high. B, a case of brass or wood, containing a sliding tube, with two or three magnifying Fig. 8.

Micro-scope.

ing glasses that may be used either separately or combined. In the inside, at the bottom, is a piece of ivory, black and white on opposite sides, that is occasionally removed, and admits a point to be screwed into the centre. The cap unscrews at D, to admit the placing of the object: the proper distance of the glasses from the object is regulated by pulling up or down the brass tube E at top containing the eye-glasses.

This microscope is particularly useful for exhibiting the well-known curious *curculio imperialis*, vulgarly called the *diamond beetle*, to the greatest advantage; for which, as well as for other objects, a glass bottom, and a polished reflector at the top, are often applied, to condense the light upon the object. In this case, the stand and brass-bottom F, as shown in the figure, are taken away by unscrewing.

9. *Mr Lyonet's Single Anatomical Dissecting Microscope.*—Fig. 9. represents a curious and extremely useful microscope, invented by that gentleman for the purpose of minute dissections, and microscopic preparations. This instrument must be truly useful to amateurs of the minutiæ of insects, &c. being the best adapted of any for the purposes of dissection. With this instrument Mr Lyonet made his very curious microscopical dissection of the *chenille de saule*, as related in his *Traité Anatomique de la chenille qui ronge le bois de saule*, 4to.

Fig. 9

AB is the anatomical table, which is supported by a pillar NO; this is screwed on the foot CD. The table AB is prevented from turning round by means of two steady pins. In this table or board there is a hole G, which is exactly over the centre of the mirror EF, that is to reflect the light on the object; the hole G is designed to receive a flat or concave glass, on which the objects for examination are to be placed.

RXZ is an arm formed of several balls and sockets, by which means it may be moved in every possible situation; it is fixed to the board by means of the screw H. The last arm IZ has a female screw, into which a magnifier may be screwed as at Z. By means of the screw H, a small motion may be occasionally given to the arm IZ, for adjusting the lens with accuracy to its focal distance from the object.

Another chain of balls is sometimes used, carrying a lens to throw light upon the object; the mirror is likewise so mounted, as to be taken from its place at K, and fitted on a clamp, by which it may be fixed to any part of the table AB.

To use the Dissecting Table.—Let the operator sit with his left side near a light window; the instrument being placed on a firm table, the side DH towards the stomach, the observations should be made with the left eye. In dissecting, the two elbows are to be supported by the table on which the instrument rests, the hands resting against the board AB; and in order to give it greater stability (as a small shake, though imperceptible to the naked eye, is very visible in the microscope), the dissecting instruments are to be held one in each hand, between the thumb and two forefingers.

II. *Of Double Microscopes, commonly called Compound Microscopes.*

Double microscopes are so called, from being a combination of two or more lenses.

Micro-scope.

The particular and chief advantages which the compound microscopes have over the single, are, that the objects are represented under a larger field of view, and with a greater amplification of reflected light.

1. *Culpeper's Microscope.*—The compound microscope, originally contrived by Mr Culpeper, is represented at fig. 10. It consists of a large external brass body A, B, C, D, supported upon three scrolls, which are fixed to the stage EF; the stage is supported by three larger scrolls, that are screwed to the mahogany pedestal GH. There is a drawer in the pedestal, which holds the apparatus. The concave mirror *I* is fitted to a socket in the centre of the pedestal. The lower part LMCD of the body forms an exterior tube, into which the upper part of the body ABLM slides, and may be moved up or down, so as to bring the magnifiers, which are screwed on at N, nearer to or farther from the object.

Fig. 10.

To *use* this microscope: Screw one of the buttons, which contains a magnifying lens, to the end N of the body: place the slider, with the objects, between the plates of the slider-holder. Then, to attain distinct vision, and a pleasing view of the object, adjust the body to the focus of the lens you are using, by moving the upper part gently up and down, and regulate the light by the concave mirror.

For opaque objects, two additional pieces must be used. The first is a cylindrical tube of brass (represented at L, fig. 11.), which fits on the cylindrical part at N of the body. The second piece is the concave speculum *h*; this is to be screwed to the lower end of the aforesaid tube: the upper edge of this tube should be made to coincide with the line which has the same number affixed to it as to the magnifier you are using; e. g. if you are making use of the magnifier marked 5, slide the tube to the circular line on the tube N that is marked also with N° 5. The slider-holder should be removed when you are going to view opaque objects, and a plane glass should be placed on the stage in its stead to receive the object; or it may be placed in the nippers, the pin of which fits into the hole in the stage.

Fig. 11.

The apparatus belonging to this microscope consists of the following particulars: viz. Five magnifiers, each fitted in a brass button; one of these is seen at N, fig. 10. Six ivory sliders, five of them with objects. A brass tube to hold the concave speculum. The concave speculum in a brass box. A fish pan. A set of glass tubes. A flat glass fitted to the stage. A concave glass fitted to the stage. A pair of forceps. A steel wire, with a pair of nippers at one end and a point at the other. A small ivory cylinder, to fit on the pointed end of the aforesaid nippers. A convex lens, moveable in a brass semicircle; this is affixed to a long brass pin, which fits into a hole on the stage.

The construction of the foregoing microscope is very simple, and it is easy in use; but the advantages of the stage and mirror are too much confined for an extensive application and management of all kinds of objects. Its greatest recommendation is its cheapness; and to those who are desirous of having a compound microscope at a low price, it may be acceptable.

2. *Cuff's Microscope.*—The improved microscope next in order is that of Mr Cuff. Besides removing the disadvantages above mentioned, it contains the addition

Micro-scope.

addition of an adjusting screw, which is a considerable improvement, and highly necessary to the examinatiou of objects under the best defined appearance from the glasses. It is represented at fig. 11. with the apparatus that usually accompanies it. A, B, C, shows the body of this microscope; which contains an eye-glass at A, a broad lens at B, and a magnifier which is screwed on at C. The body is supported by the arm DE, from which it may be removed at pleasure. The arm DE is fixed on the sliding bar F, and may be raised or depressed to any height within its limits. The main pillar *a b* is fixed in the box *b e;* and by means of the brass foot *d* is screwed to the mahogany pedestal XY, in which is a drawer containing all the apparatus. O is a milled-headed screw, to tighten the bar F when the adjusting screw *c g* is used. *p q* Is the stage, or plate, which carries the objects; it has a hole at the centre *n*. G, a concave mirror, that may be turned in any direction, to reflect the light of a candle, or the sky, upon the object.

Fig. 11.

To *use* this microscope: Screw the magnifier you intend to use to the end C of the body; place the slider-holder P in the hole *n*, and the slider with the object between the plates of the slider-holder; set the upper edge of the bar DE to coincide with the divisions which correspond to the magnifier you have in use, and pinch it by the milled nut; now reflect a proper quantity of light upon the object, by means of the concave mirror G, and regulate the body exactly to the eye and the focus of the glasses by the adjusting screw *c g*.

To view *opaque* objects, take away the slider-holder P, and place the object on a flat glass under the centre of the body, or on one end of the jointed nippers *o p*. Then screw the silver concave speculum *h* to the end of the cylinder L, and slide this cylinder on the lower part of the body, so that the upper edge thereof may coincide with the line which has the same mark with the magnifier that is then used: reflect the light from the concave mirror G to the silver speculum, from which it will again be reflected on the object. The glasses are to be adjusted to their focal distance as before directed.

The *apparatus* consists of a convex lens H, to collect the rays of light from the sun or a candle, and condense them on the object. L a cylindrical tube, open at each side, with a concave speculum screwed to the lower end *h*. P the slider-holder: this consists of a cylindrical tube, in which an inner tube is forced upwards by a spiral spring; it is used to receive an ivory slider K, which is to be slid between the plates *h* and *i*. The cylinder P fits the hole *n* in the stage; and the hollow part at *k* is designed to receive a glass tube. R is a brass cone, to be put under the bottom of the cylinder P, to intercept occasionally some of the rays of light. S, a box containing a concave and a flat glass, between which a small living insect may be confined: it is to be placed over the hole *n*. T, a flat glass, to lay any occasional object upon; there is also a concave one for fluids. O is a long steel wire, with a small pair of pliers at one end, and a point at the other, designed to stick or hold objects: it slips backwards and forwards in the short tube *o;* the pin *p* fits into the hole of the stage. W, a little round ivory box, to hold a supply of talc and rings for the sliders. V, a small ivory cylinder, that fits on the pointed end of the steel wire: it is designed for opaque objects. Light-coloured ones are to be stuck upon the dark side, and *vice versa*. M, a fish-pan, whereon to fasten a small fish, to view the circulation of the blood: the tail is to be spread across the oblong hole *k* at the small end, and tied fast, by means of a rib-band fixed thereto; the knob *l* is to be shoved through the slit made in the stage, that the tail may be brought under the magnifier.

Micro-scope.

3. This microscope has received several material improvements from Mr Martin, Mr Adams, &c. By an alteration, or rather an enlargement, of the body of the tube which contains the eye-glasses, and also of the eye-glasses themselves, the field of view is made much larger, the mirror below for reflecting light is made to move upon the same bar with the stage; by which means the distance of it from the stage may be very easily and suitably varied. A condensing glass is applied under the stage in the slider-holder, in order to modify and increase the light that is reflected by the mirrors below from the light of a candle or lamp. It is furnished also with two mirrors in one frame, one concave and the other plane, of glass silvered; and by simply unscrewing the body, the instrument, when desired, may be converted into a single microscope. Fig. 12. is a representation of the instrument thus improved; and the following is the description of it, as given by Mr Adams in his Essays. Fig. 12.

AB represents the body of the microscope, containing a double eye-glass and a body-glass; it is here shown as screwed to the arm CD, from whence it may be occasionally removed, either for the convenience of packing, or when the instrument is to be used as a single microscope.

The eye-glasses and the body-glasses are contained in a tube which fits into the exterior tube AB; by pulling out a little this tube when the microscope is in use, the magnifying power of each lens is increased.

The body AB of the microscope is supported by the arm CD; this arm is fixed to the main pillar CF, which is screwed firmly to the mahogany pedestal GH; there is a drawer to this pedestal, which holds the apparatus.

NIS, the plate or stage which carries the slider-holder KL; this stage is moved up or down the pillar CF, by turning the milled nut M; this nut is fixed to a pinion, that works in a toothed rack cut on one side of the pillar. By means of this pinion, the stage may be gradually raised or depressed, and the object adjusted to the focus of the different lenses.

KL is a slider-holder, which fits into a hole that is in the middle of the stage NIS; it is used to confine and guide either the motion of the sliders which contain the objects, or the glass tubes that are designed to confine small fishes for viewing the circulation of the blood. The sliders are to be passed between the two upper plates, the tubes through the bent plates.

L is a brass tube, to the upper part of which is fixed the condensing lens before spoken of; it fits into the under part of the slider-holder KL, and may be set at different distances from the object, according to its distance from the mirror or the candle.

O is the frame which holds the two reflecting mirrors,

Micro-scope.

rors, one of which is plane, the other concave. These mirrors may be moved in various directions, in order to reflect the light properly, by means of the pivots on which they move, in the semicircle QSR, and the motion of the semicircle itself on the pin S: the concave mirror generally answers best in the day-time; the plane mirror combines better with the condensing lens, and a lamp or candle. At D there is a socket for receiving the pin of the arm Q (fig. 31.) to which the concave speculum, for reflecting light on opaque objects, is fixed. At S is a hole and slit for receiving either the nippers L (fig. 31.) or the fish-pan I; when these are used, the slider-holder must be removed. T, a hole to receive the pin of the convex lens M.

Plate CCCXLI. fig. 31.

To *use* this microscope: Take it out of the box. Screw the body into the round end of the upper part of the arm CD. Place the brass sliders, which contain the magnifiers, into the dove-tailed slit which is on the under side of the aforesaid arm, as seen at E, and slide it forwards until the magnifier you mean to use is under the centre of the body: opposite to each magnifier in this slit there is a notch, and in the dove-tailed part of the arm CD there is a spring, which falls into the above-mentioned notch, and thus makes each magnifier coincide with the centre of the body. Pass the ivory slider you intend to use between the upper plates of the slider-holder KL, and then reflect as strong a light as you can on the subject by means of one of the mirrors; after this, adjust the object to the focus of the magnifier and your eye, by turning the milled screw M, the motion of which raises and depresses the stage NIS. The degree of light necessary for each object, and the accuracy required in the adjustment of the lenses to their proper focal distance from the object, will be easily attained by a little practice.

When *opaque* objects are to be examined, remove the slider-holder, and place the object on a flat glass, or fix it to the nippers L, the pin of these fit into the hole on the stage; screw the concave speculum R into the arm Q (fig. 31.), and then pass the pin of this arm through the socket D (fig. 12.); the light is now to be reflected from the concave mirror to the silver speculum, and from this down on the object. No exact rule can be given for reflecting the light on the object; we must therefore refer the reader to the mother of all aptness, practice. The speculum must be moved lower or higher, to suit the focus of the different magnifiers and the nature of the object.

The foregoing directions apply equally to the using of this instrument as a *single microscope*; with this difference only, that the body AB is then removed, and the eye is applied to the upper surface of the arm CD, exactly over the magnifiers.

This microscope is sometimes made with the following *alterations*, which are supposed to make it still more convenient and useful. The arm CD that carries the body and magnifiers is made both to turn on a pin, and to slide backwards and forwards in a socket at C; so that, instead of moving the objects below on the stage, and disturbing them, the magnifiers are more conveniently brought over any part of the objects as desired. The condensing glass is made larger, and slides upon the square bar CF quite distinct from the stage, like the mirrors below; and it is thereby made useful for any other objects that may be applied on glasses fitted to the stage, as well as those put into the slider-holder K. It is thereby not confined to this stage alone as in the preceding. When the body AB is taken away, the arm CD may be slipt away from its bar, with the magnifiers, and the forceps, wire, and joint, applied to it; and it thereby serves the purpose of a small single or opaque hand microscope, for any object occasionally applied to this wire. The magnifiers in the slider E are mounted in a wheel case, which perhaps prevents its being in the way so much as the long slider E before described.—This contrivance is represented at X, fig. 12.

Micro-scope.

4. *Martin's New Universal Compound Microscope.*—This instrument was originally constructed by Mr B. Martin, and intended to comprise all the uses and advantages of the single, compound, opaque, and aquatic microscopes. The following is a description of it.

Fig. 13. is a representation of the instrument placed up for use. ABCD is the body of the microscope: which consists of four parts, viz. AB the eye-piece, or that containing the eye-glasses, and is screwed into C, which is a moveable or sliding tube on the top; this inner tube contains the body-glass screwed into its lower part. D is the exterior tube or case, in which the other slides up and down in an easy and steady manner. This motion of the tube C is useful to increase and decrease the magnifying power of the body-glass when thought necessary, as before mentioned. E is a pipe or snout screwed on to the body of the microscope D, and at its lower part, over the several magnifying lenses hereafter described. FGHI is the square stem of the microscope, upon which the stage R moves in an horizontal position, upwards or downward, by means of the fine rack work of teeth and pinion. KL is a strong solid joint and pillar, by which the position of the instrument is readily altered from a vertical one to an oblique or to a perfectly horizontal one as may be required: it is thus well adapted to the ease of the observer either sitting or standing; and as it is very often convenient to view objects by direct unreflected light, when the square stem FI is placed in a horizontal position for this purpose, the mirror T is then to be taken off in order to prevent the obstruction of the rays. M is a circular piece of brass, serving as a base to the pillar. NOP, the tripod or foot by which the whole body of the microscope is steadily supported; it folds up when packed into the case. W is a brass frame, that contains the condensing lens, and acts in conjunction with the large concave and plane mirrors below at T; the reflected rays from which, either of the common light or of that of a candle or lamp, it agreeably modifies, and makes steady in the field of view.

Plate CCCXXXIX. fig. 13.

The particulars of the apparatus to this microscope are as follow: Q is a circular brass box, containing six magnifiers or object lenses, numbered 1, 2, 3, 4, 5, 6; the digits of which appear severally through a small round hole in the upper plate of it. To the upper side is fixed a small circle of brass, by which it is connected with, and screwed into, the round end of the arm *a b c d*; which is a long piece of brass, and moves through either by teeth or pinion, or not, as may be desired, in *e f*; which is a socket on the upper part of the pillar, and admits, with a motion both easy and steady, the

brass

Micro-scope.

brass arm. R is a fixed stage, upon which the objects to be viewed are to be placed: it is firmly fastened to the square pillar, which is moved by the rack-work. In the middle is a large circular hole, for receiving concave glasses, with fluids, &c.; it has also a sliding spring frame to fasten down slips of glass or other things: at *abc* are three small sockets or holes, intended to receive several parts of the apparatus. S is the refractor, or illuminating lens, for converging the sun's rays upon opaque objects laid upon the stage R. To this purpose it moves on a semicircle upon a long shank *g*, in a spring socket *h*, in the arm *i*; this arm moving every way by a stout pin *k* in the socket *a* of the stage. In this manner it is easily adjusted to any position of the sun, candle, &c.—T, the reflecting-glass frame, containing a concave and plane speculum, which is moved upon the square pillar by the hand. The use of it is to illuminate all transparent objects that are applied to the stage above.

Fig. 14.

Fig. 14. N° 1. is an auxiliary moveable stage; which by means of a pin *k* is placed in the hole *a* of the stage R, and can be moved in a horizontal direction over the whole field of the stage. In this stage, there are three circular holes with shouldered bottoms; a large one in the middle, and on each side a small one, for the reception of the three following necessary articles: N° 2. a watch-glass to be placed in the large hole, to hold fluids containing animalcules, &c.; a circular piece of ivory, N° 3. one side of which is black, the other white, to support opaque objects of different contrasted colours; and circular plane and concave glasses, N° 4. for extemporaneous transparent objects.—The same use is made of the other small hole as of the large one, only in a lesser degree, to receive small concave glasses, plates, &c.

N° 5. is the silvered speculum, called a *liberkhun*, which makes the single opaque microscope, by being screwed to the slider *a b c d* (fig. 13.) in room of the box of lenses Q, and the body AE above it. The chief use of this is to view very small objects strongly illuminated near the compounded focus of the mirror T (fig. 13.). N° 6. is the forceps or pliers, for holding such kind of objects, and by which they can be applied very readily to the focus of the lens in the liberkhun. They have a motion all ways by means of the spring socket *a*, the joint *b*, and the shank *c*: they are placed in the socket *c* of the fixed stage R (fig. 13.). N° 7. is a small piece of ivory, to be placed upon the pointed end of the pliers: it is black upon one side, and white upon the other, to receive opaque objects.

N° 8. is a liberkhun of a larger size than that first mentioned, with a hole in its centre: this is screwed into N° 9. the hole *a* of a brass ring, fastened to a long wire *b*; which moves up and down in the spring socket *b* of the stage R, in which it also moves sideways; and thus, with the body AE above, forms an *aquatic compound microscope* for showing all sorts of objects in water and other fluids placed under it in the watch-glass N° 2. on the stage.

N° 11. is a cone, with a proper aperture *a* to exclude superfluous light, that would disturb a critical observation of a curious object; it is placed on the under side of the fixed stage R.

N° 12. is what is usually called a bug-box, consisting of a concave glass with a plane one screwed over it; by means of which a bug, louse, flea, &c. may be secured and viewed alive. It is to be placed on either of the stages R (fig. 13.), or N° 1. (fig. 14.). Micro-scope.

N° 13. is the fish pan. In the long concave body *a b*, a fish may be so confined by the ribband *c*, that the transparent tail may be in part over the slit or hole at *a*. In this state, it is placed on the stage R, with the pin *d* in the hole *c* of the stage, and moves freely and horizontally for viewing the circulation of the blood, &c.

N° 14. is the slider-holder that is placed on the stage R: it receives the sliders and tubes when filled with transparent objects, to be viewed either by the compound or single microscope.

N° 15. represents the ivory slider, to hold the objects between the tales as usual.

N° 16. is a useful auxiliary slider framed in brass. In this slider small concave glasses are cemented; and a slip of plane glass slides over them; by which any small living object, as mites, &c. may be confined without injury, and deliberately viewed.

N° 17. represents a set of glass tubes, three in number, one within another; they are useful for small tadpoles, water newts, eels, &c. when the circulation of the blood is to be viewed. There is a small hole at one end of each tube, that serves to admit the air; for when they are filled with water, the other end is stopped with a cork.

N° 18. is a small ivory box, containing spare tales and wires, to supply the sliders with occasionally.

N° 19. a brass cell or button, containing a very small lens, properly set between two small plates of brass, that it may be brought very near to the object when viewed therewith as a single microscope. This magnifier is screwed into the same hole as the wheel of six magnifiers Q are (fig. 13.).

N° 20. is a lens, adapted to view and examine objects, by magnifying them sufficiently, so as to be able to apply them to the microscope for inspection: on this account it is called the *explorator*.

The preceding are the chief articles of the apparatus: which, on account of their being somewhat different from what is applied to other microscopes, we have been thus particular in describing. In using the microscope, and while viewing objects by either the single or compound instrument, the focal distances of the magnifiers are made perfectly exact by turning of the pinion at the nut *w*, in one way or the other, very gently in the teeth of the rack-work at X (fig. 13.).

It is necessary that the centres of the object-lenses or magnifiers, the stage, and the mirrors at bottom, should all be in a right line in the axis of the microscope, when opaque objects are to be viewed, that are placed upon the ivory piece N° 7. or the forceps N° 6. and all other such sort of objects which are placed in the centre of the stage R, or slider-holder N° 14: But when aquatic or living objects, which require a great space to move in, are to be viewed, then the horizontal motion at *e f* (fig. 13.) is made use of, and the view may be extended laterally over the whole of the diameter of the object or field of view; and by putting the arm *a b c d* forward or backward in its socket *e f*, the view is extended in the contrary direction

Micro scope.

direction equally well; and in this manner the whole of the objects may be viewed without the least disturbance.

As the brass arms *a b c d* may be brought to the height of three or four inches above the stage R; so, by means of the rack-work motion of the stage, a lens of a greater focal distance than the greatest in the wheel Q may be occasionally applied in place of the wheel, and thereby the larger kind of objects be viewed; the instrument becoming, in this case, what is called a *megalascope*.

In viewing moving living objects, or even fixed ones, when nice motions are requisite, a rack-work and pinion is often applied to the arm *a b c d:* the arm is cut out with teeth; and the pinion, as shown at Y, is applied to work it. This acts but in one direction; and, in order to produce an equally necessary motion perpendicular to this, rack-work and pinion is applied tangent-wise to the stage, which is then jointed.

What has been related above respects the construction of those denominated *parlour* microscopes, in contradistinction to those which are portable: their dimensions, however, have been considerably reduced by opticians, in order to render them fit for the pocket; and as they are for the most part constructed on nearly the same principles as those which have been already described, what has been said will sufficiently instruct our readers in using any pocket microscope whatever. Only it may be observed, that in those reduced instruments, both the field of view and the magnifying power are proportionably diminished.

We shall conclude the account of this sort of microscope with descriptions of a very portable pocket apparatus of microscopic instruments, and of a new microscopic pocket telescope, both invented by the late Mr B. Martin, and since made by most instrument-makers in London.

Fig. 15.

The former is represented at fig. 15. It consists of two parts, viz. the body *a b*, and the pedestal *i k*, which is joined by a screw at the part between *b* and *i*. It consists of three cylindric tubes, viz. (1.) the exterior tube, or case, *a b;* (2.) a middle tube *c b;* and (3.) the interior tube *f g*. The middle tube *c d* is the adjuster; and is connected with the outer tube by the rack-work of teeth and pinion, as shown at *e:* by which means it is moved up and down at pleasure through the smallest space, and carries with it the internal tube *f g*. The interior tube *f g* receives on its lower part at *b* the several capsules or boxes 2, 3, 4, 5, (fig. 16.) which contain the object lenses or magnifiers.

The method of *using* this compound microscope in the perpendicular position, is as follows: The stage N° 1. is put within the exterior tube at *b*. Under the springs are applied the four ivory sliders, which contain a variety of transparent objects; then move the interior tube *f g* up and down with the hand, till you discern the object in the slider, and there let it rest. After this, turn the pinion at *e* very tenderly one way or the other, till you obtain a perfect view of the transparent objects properly illuminated, from a mirror contained in the pedestal or stand *i k*, suspended upon, and moveable about, the points of two screws (*l l*). N° 6. (fig. 16.) represents a moveable stage, which is placed in the spring socket *m*. It contains a concave glass, for the reception of animalcules in fluids; and has the advantage of bringing any part into view by moving the handle at *n*. If living and moving objects are required to be shown, they must be confined in the concave, by putting a glass cover, N° 7. upon the stage; and then a small spider, a louse, a flea, bug, &c. may be seen, and the motion or circulation of the blood, &c. observed with surprising distinctness.

Micro scope.

Fig. 16.

To view the circulation of the blood in the most eminent degree, it must be done by placing small frogs, tadpoles, water-newts, fishes, &c. in a tube as represented N° 8. (fig. 17.); which tube is placed in the holes *o* in the opposite sides of the case *a b*, fig. 15. in the lower part.—N° 9. (fig. 16.) is a pair of pincers or pliers *d*, for holding any object; the other end of the steel wire is pointed to receive a piece of ivory *b*, with one end black, and the other white, on which you stick objects of different hue: this also, when used, is placed in the spring socket *m*.

Fig. 17.

To use this instrument as a compound opaque, you screw off the body part *a b*, and screw to it the handle *r* (fig. 16.); by this means you may hold the microscope in a horizontal position, as shown in the figure. The silver dish or speculum (which is contained in the bottom or base *k*, fig. 15.), is then screwed on at *b*. N° 9. is placed in the spring socket *m*, and adjusted backward and forward in *m*, till the reflected light from the speculum falls in a proper manner on the opaque object. Either of the four magnifiers, 2, 3, 4, 5, may be used, and brought to a proper focus, as before described by the tooth and pinion *e* (fig. 15.). If you take off the opaque apparatus, and apply the stage N° 1. (fig. 16.) with an ivory slider, and at the end *b* screw in either of the two lenses, N° 10. (which are distinguished by the name of illuminators), the microscope being held up to the light (and properly adjusted), the whole field of view will be strongly illuminated, and present a most pleasing appearance of any transparent object. These two convex lenses are of different focuses, and are to be used singly or together; N° 2. being the greatest magnifier, will require the object to be strongly illuminated, and of course both the lenses must be used together. By candle-light, this method of viewing transparent objects will prove very entertaining; by screwing the handle *r* into the part *s* of N° 10. it becomes a delightful hand megalascope for viewing flowers, fossils, shells, &c.; and each lens, as before mentioned, having a different focus, produces two magnifying powers used singly, and when combined a third.

The manner of using this instrument as a single microscope (like Wilson's) is represented in fig. 17. where the button or magnifier at each is to be screwed off, and the circular piece N° 11. is screwed in its place. This piece has a spring socket made to receive the slider-holder N° 12. N° 13. is a circular piece of brass, with a long shank and spring, and is introduced through the outside tube *a b* at *t*. N° 2, 3, 4, 5, are screwed occasionally in the centre of this piece, and used as single lenses with ivory sliders, &c. N° 14. contains a lens of a great magnifying power, for viewing very minute objects: to render this instrument the most complete single opaque microscope, you have only to screw into N° 13

Micro-scope.

the silver speculum N° 15. which has a small lens set in its centre. The slider-holder N° 12. is taken out of N° 11, and the pincers or nippers *d b*, being detached from the other part of N° 9. are passed through the long spring socket N° 11. and ready to receive any opaque body in the pincers, or on the black and white piece of ivory. To the large screw of N° 13. are applied the two lenses N° 10. which make it the completest megalascope that can be desired.

The handle *r* contains the four ivory sliders with objects.

The shagreen case which contains this universal microscope and its apparatus, is six inches long, three inches wide, two inches deep; and weighs together 16 ounces. "Thus (says Mr Martin) so small, so light, so portable, and yet so universally complete, is this pocket microscopic apparatus, that you find nothing material in the large three-pillared microscope, the opaque microscope, Wilson's single microscope, and the aquatic microscope, all, together, which you have not in this; besides some very considerable advantages in regard to the field of view, &c. which they have not (A)."

This inventive artist having contrived a construction of the compound microscope so small as to admit of being packed in a common walking cane, thought next of introducing the same instrument into the inside of what he called his *Pocket Three-brass drawer Achromatic Telescope*. The same eye glasses that serve the purpose of a telescope, answer as the compound magnifier, for viewing transparent and opaque objects in a microscope.

Fig. 18, 19, 20, represent the telescope separated by unscrewing it at *m*, in order that the whole of the necessary parts in use may be exhibited. Fig. 19. represents the exterior tube, which is of mahogany, and its rims of brass. It is detached from the rest of the telescope, as not making any part of the microscope. The brass cover *k l*, that shuts up the object-glass of the telescope, is also the box which contains the two-wheel object frames, and a small plain reflecting mirror.

In fig. 20. A is the cover taken off, by unscrewing the top part: The mirror B is taken out; and also, by unscrewing the bottom part, the two circular wheels, with the objects shown in C and D.

Fig. 18. is a representation of the three internal brass sliding tubes of the telescope, which form the microscopic part. The tubes are to be drawn out as shown in this figure; then, at the lower end of the large tube in the inside, is to be pulled out a short tube *b c*, that serves as a kind of stage to hold the wheels, with objects, and support the reflecting mirror. This tube is to be partly drawn out, and turned so that the circular hole that is pierced in it may coincide with a similar hole that is cut in the exterior tube. This tube is represented as drawn out in the figure; and the mirror B placed therein, and the wheel with transparent objects. C (fig. 20.) represents the wheel with transparent objects, and D the wheel with opaque objects. They are both made of ivory; and turn round upon a centre brass pin slit upon the top, which fits upon the edge of the tube; which tube is then to be pushed up into the telescope tube, so that its lower end may rest upon the upper edge of the wheel according to its view at *a*, fig. 18.

Micro-scope.

In viewing the objects, the second brass tube of the telescope must be pushed down, till its milled edge at top falls upon that of the exterior tube; taking care that the circular hole is duly placed to the exterior one. These circular holes are not seen in fig. 18. being supposed in the opposite side, where the wheel is fixed. The adjustment for the focus is now only necessary; which is obtained by pushing downwards or upwards the proper tube, till the object appear quite distinct. In viewing transparent objects, the instrument may be used in two positions; one vertical, when the light is to be reflected upon the object by the mirror; the other, by looking up directly against the light of a candle, common light, &c.; in which case the mirror must be taken away. In viewing opaque objects, the mirror is not used; but as much common light as possible must be admitted through the circular holes in the sides of the tubes.

There is a spare hole in the transparent wheel, and also one in the opaque, to receive any occasional object that is to be viewed. Any sort of object whatsoever may be viewed, by only pushing up the microscope tube into its exterior, and bringing the first eye-tube to its focal distance from the object.

The brass tubes are so contrived, that they stop when drawn out to the full length: so that by applying one hand to the outside tube, and the other to the end of the smallest tube, the telescope at one pull may be drawn out; then any of the tubes (that next to the eye is best) may be pushed in gradually, till the most distinct view of the object be obtained.

The tubes all slide through short brass spring tubes, any of which may be unscrewed from the ends of the sliding tubes by means of the milled edges which project above the tubes, taken from each other, and the springs set clear if required.

III. *Of Solar Microscopes.*

This instrument, in its principle, is composed of a tube, a looking-glass or mirror, a convex lens, and Wilson's single microscope before described. The sun's rays being reflected through the tube by means of the mirror upon the object, the image or picture of the object is thrown distinctly and beautifully upon a screen of white paper or a white linen sheet, placed at a proper distance to receive the same; and may be magnified

(A) Notwithstanding the properties that have been ascribed to the above instrument, and the praises bestowed upon it by some, which induced us to admit so minute a description, we must apprise our readers, that it has been omitted in Mr Adams's enumeration; and upon inquiry we learn, that it has fallen into neglect among the most judicious opticians, being found too imperfect to serve the purposes of science, and too complicated for the use of persons who seek only entertainment.

Microscope.

magnified to a size not to be conceived by those who have not seen it: for the farther the screen is removed, the larger will the object appear; insomuch, that a louse may thus be magnified to the length of five or six feet, or even a great deal more; though it is more distinct when not enlarged to above half that size.

Plate CCCXL. fig. 21.

The different forms in which the Solar Microscope is constructed, are as follow.

I. The old construction is represented in fig. 21. A is a square wooden frame, through which pass two long screws assisted by a couple of nuts 1, 1. By these it is fastened firmly to a window shutter, wherein a hole is made for its reception; the two nuts being let into the shutter, and made fast thereto. A circular hole is made in the middle of this frame to receive the piece of wood B, of a circular figure; whose edge, that projects a little beyond the frame, composes a shallow groove 2, wherein runs a catgut 3; which, by twisting round, and then crossing over a brass pulley 4, (the handle whereof 5, passes through the frame), affords an easy motion for turning round the circular piece of wood B, with all the parts affixed to it. C is a brass tube, which, screwing into the middle of the circular piece of wood, becomes a case for the uncovered brass tube D to be drawn backwards or forwards in. E is a smaller tube, of about one inch in length, cemented to the end of the larger tube D. F is another brass tube, made to slide over the above described tube E; and to the end of this the microscope must be screwed, when we come to use it. 5. A convex lens, whose focus is about 12 inches, designed to collect the sun's rays, and throw them more strongly upon the object. G is a looking-glass of an oblong figure, set in a wooden frame, fastened by hinges in the circular piece of wood B, and turning about therewith by means of the above-mentioned catgut. H is a jointed wire, partly brass and partly iron; the brass part whereof 6, which is flat, being fastened to the mirror, and the iron part 7, which is round, passing through the wooden frame, enable the observer, by putting it backwards or forwards, to elevate or depress the mirror according to the sun's altitude. There is a brass ring at the end of the jointed wire 8, whereby to manage it with the greater ease. The extremities of the catgut are fastened to a brass pin, by turning of which it may be braced up, if at any time it becomes too slack.

When this microscope is employed, the room must be rendered as dark as possible; for on the darkness of the room, and the brightness of the sunshine, depend the sharpness and perfection of your image. Then putting the looking-glass G through the hole in your window shutter, fasten the square frame A to the shutter by its two screws and nuts 1, 1. This done, adjust your looking-glass to the elevation and situation of the sun, by means of the jointed wire H, together with the catgut and pulley, 3, 4. For the first of these raising or lowering the glass, and the other inclining it to either side, there results a twofold motion, which may easily be so managed as to bring the glass to a right position, that is, to make it reflect the sun's rays directly through the lens 5, upon the paper screen, and form thereon a spot of light exactly round. But though the obtaining a perfect circular spot of light upon the screen before you apply the microscope, is a certain proof that your mirror is adjusted right, that proof must not always be expected: for the sun is so low in winter, that if it shine in a direct line against the window, it cannot then afford a spot of light exactly round; but if it be on either side, a round spot may be obtained, even in December. As soon as this appears, screw the tube D into the brass collar provided for it in the middle of your wood-work, taking care not to alter your looking-glass: then screwing the magnifier you choose to employ to the end of your microscope in the usual manner, take away the lens at the other end thereof, and place a slider, containing the objects to be examined, between the thin brass plates, as in the other ways of using the microscope.

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Things being thus prepared, screw the body of the microscope over the small end E of the brass tube F; which slip over the small end E of the tube D, and pull out the said tube D less or more as your object is capable of enduring the sun's heat. Dead objects may be brought within about an inch of the focus of the convex lens 5; but the distance must be shortened for living creatures, or they will soon be killed.

If the light fall not exactly right, you may easily, by a gentle motion of the jointed wire and pulley, direct it through the axis of the microscopic lens. The short tube F, to which the microscope is screwed, renders it easy, by sliding it backwards or forwards on the other tube E, to bring the objects to their focal distance; which will be known by the sharpness and clearness of their appearance: they may also be turned round by the same means without being in the least disordered.

The magnifiers most useful in the solar microscope are in general, the fourth, fifth, or sixth. The screen on which the representations of the objects are thrown, is usually composed of a sheet of the largest elephant paper, strained on a frame which slides up or down, or turns about at pleasure on a round wooden pillar, after the manner of some fire screens. Larger screens may also be made of several sheets of the same paper pasted together on cloth, and let down from the ceiling with a roller like a large map.

"This microscope (says Mr Baker) is the most entertaining of any; and perhaps the most capable of making discoveries in objects that are not too opaque: as it shows them much larger than can be done any other way. There are also several conveniences attending it, which no other microscope can have: for the weakest eyes may use it without the least straining or fatigue: numbers of people together may view any object at the same time; and by pointing to the particular parts thereof, and discoursing on what lies before them, may be able better to understand one another, and more likely to find out the truth, than in other microscopes, where they must peep one after another, and perhaps see the object neither in the same light nor in the same position. Those also, who have no skill in drawing, may, by this contrivance, easily sketch out the exact figure of any object they have a mind to preserve a picture of; since they need only fasten a paper on the screen, and trace it out thereon either with a pen or pencil, as it appears before them. It is worth

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the while of those who are desirous of taking many draughts in this way, to get a frame, wherein a sheet of paper may be put in or taken out at pleasure; for if the paper be single, the image of an object will be seen almost as plainly on the back as on the fore side; and, by standing behind the screen, the shade of the hand will not obstruct the light in drawing, as it must in some degree when one stands before it." This construction, however, has now become rather obsolete, and is superseded by the following.

II. *The improved Solar Microscope, as used with the improved single Microscope, with teeth and pinion.* Fig. 22. represents the whole form of the *single microscope;* the parts of which are as follows: ABCD the external tube; GHIK the internal moveable one; QM part of another tube within the last, at one end of which is fixed a plate of brass hollowed in the middle, for receiving the glass tubes; there is also a moveable flat plate, between which, and the fixed end of the second tube, the ivory sliders are to be placed. L, a part of the microscope, containing a wire spiral spring, keeping the tube QM with its plates firm against the fixed part IK of the second tube.

Fig. 22.

EF is the small rack-work of teeth and pinion, by which the tube IG is moved gradually to or from the end AB, for adjusting the objects exactly to the focus of different lengths. NO is a brass slider, with six magnifiers; any one of which may easily be placed before the object. It is known when either of the glasses is in the centre of the eye-hole, by a small spring falling into a notch in the side of the slider, made against each of the glasses. Those parts of the apparatus, fig. 14. marked N° 15, 16, 17, 18, 19, 20, 21, and 22. are made use of here to this microscope. GH is a brass cell, which holds an illuminating glass for converging the sun's beams or the light of a candle strongly upon the objects. The aperture of the glass is made greater or less, by two circular pieces of brass, with holes of different sizes, that are screwed separately over the said lens. But at times objects appear best when the microscope is held up to the common light only, without this glass. It is also taken away when the microscope is applied to the apparatus now to be described.

Plate CCCXXXXIX.

Fig. 23. represents the apparatus, with the single microscope screwed to it, which constitutes the *Solar Microscope.* AB is the inner moveable tube, to which the single microscope is screwed. CD is the external tube, containing a condensing convex glass at the end D, and is screwed into the plate EF, which is cut with teeth at its circumference, and moved by the pinion I, that is fixed with the plate GH. This plate is screwed fast against the window-shutter, or board fitted to a convenient window of a darkened room, when the instrument is used. KL is a long frame, fixed to the circular plate EF; containing a looking-glass or mirror for reflecting the solar rays through the lens in the body of the tube D. O is a brass milled head, fastened to a worm or endless screw; which on the outside turns a small wheel, by which the reflecting mirror M is moved upwards and downwards.

Fig. 23.

In *using* this microscope, the square frame GH is first to be screwed to the window shutter, and the room well darkened: which is best done by cutting a round hole of the size of the moveable plate EF, that carries the reflector, in the window-shutter or board; and, by means of two brass nuts *a a*, let into the shutter to receive the screws PP, when placed through the holes in the square frame GH, at the two holes QQ: which will firmly fasten the microscope to the shutter, and is easily taken away by only unscrewing the screws PP.

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The white paper screen, or white cloth, to receive the images, is to be placed several feet distant from the window: which will make the representations the larger in proportion to the distance. The usual distances are from 6 to 16 feet.

The frame KL, with its mirror M, is to be moved by turning the pinion I, one way or the other, till the beams of the sun's light come through the hole into the room: then, by turning of the worm at O, the mirror must be raised or depressed till the rays become perfectly horizontal, and go straight across the room to the screen. The tube CD, with its lens at D, is now to be screwed into the hole of the circular plate EF: by this glass the rays will be converged to a focus; and from thence proceed diverging to the screen, and there make a large circle of light. The single microscope, fig. 22. is to be screwed on to the end AB (fig. 23.) of the inner tube; and the slider NO, with either of the lenses marked 1, 2, 3, 4, 5, or 6, in the centre of the hole at the end AB. This will occasion a circle of light upon the screen much larger than before. The slider or glass-tube, with the objects to be viewed, is to be placed between the plates at IK against the small magnifier, and moved at pleasure. By shifting the tube AB in or out, you may place the object in such a part of the condensed rays as shall be sufficient to illuminate it, and not scorch or burn it; which will generally require the glass to be about one inch distant from the focus. It now remains only to adjust the object, or to bring it so near to the magnifier that its image formed upon the screen shall be the most distinct or perfect: and it is effected by gently turning the pinion F, fig. 22. a small matter one way or the other. If the object be rather large in size, the least magnifiers are generally used, and *vice versa.*

N° 1. is the greatest magnifier, and N° 6. the least, in the brass slider NO. But, if desired, single lenses of greater magnifying powers are made: and they are applied, by being screwed to the end AB, fig. 22. and the brass slider NO is then taken away.

The same object may be variously magnified, by the lenses severally applied to it; and the degree of magnifying power is easily known by this rule: *As the distance of the object is to that of its image from the magnifier; so is the length or breadth of the object to that of the image.*

Instead of the brass sliders with the lenses NO, there is sometimes screwed a lens of a large size, and longer focal distance: the instrument is then converted into a *megalascope;* and is adapted for viewing the larger kind of objects contained in large sliders, such as is represented at R. And, in the same manner, small objects of entertainment, painted upon glass like the sliders of a magic lanthorn, are much magnified, and represented upon the same screen.

The solar microscopes just described are capable only of magnifying transparent objects; for which pur-

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pose the last instrument is extremely well adapted. But as opaque objects form the most considerable part of the curious collections in the works of art as well as nature, a solar microscope for this purpose was a long time wanted.—For several years previous to 1774, Mr Martin made several essays towards the construction of such an instrument; and at last completed one about the time just mentioned, which he named,

III. *The Opaque Solar Microscope.* With this instrument (to use his own words) "all *opaque* objects, whether of the animal, vegetable, or mineral kingdom, may be exhibited in great perfection, in all their native beauty; the lights and shades, the prominences and cavities, and all the varieties of different hues, tints, and colours; heightened by reflection of the solar rays condensed upon them.—*Transparent objects* are also shown with greater perfection than by the common solar microscope."

Fig. 24. represents the solar opaque microscope, mounted for exhibiting opaque objects.

Fig. 25. is the single tooth and pinion microscope, as before, which is used for showing transparent objects; the cylindrical tube Y thereof being made to fit into the tube FE of the solar microscope.

Fig. 24. ABCDEF, (fig. 24.) represents the body of the solar microscope; one part thereof, ABCD, is conical; the other, CDEF, is cylindrical. The cylindrical part receives the tube G of the opaque box, or the tube Y of the single microscope. At the large end AB of the conical part, there is a lens to receive the rays from the mirror, and refract them towards the box HIKL. NOP is a brass frame; which is fixed to the moveable circular plate *a b c*: in this frame there is a plane mirror, to reflect the solar rays on the aforementioned lens. This mirror may be moved into the most convenient position for reflecting the light, by means of the nuts Q and R. By the nut Q it may be moved from east to west; and it may be elevated or depressed by the nut R. *d e*, Two screws to fasten the microscope to a window shutter. The box for opaque objects is represented at HIKL: it contains a plane mirror M, for reflecting the light which it receives from the large lens to the object, and thereby illuminating it; S is a screw to adjust this mirror, or place it at a proper angle for reflecting the light. VX, two tubes of brass, one sliding within the other, the exterior one in the box HIKL; these carry the magnifying lenses: the interior tube is sometimes taken out, and the exterior one is then used by itself. Part of this tube may be seen in the plate within the box HIKL. At H there is a brass plate, the back part of which is fixed to the hollow tube *h*, in which there is a spiral wire, which keeps the plate always bearing against the side H of the brass box HIKL. The sliders, with the opaque objects, pass between this plate and the side of the box; to put them there, the plate is to be drawn back by means of the nut *g*: *i k* is a door to one side of the opaque box. The foregoing pieces constitute the several parts necessary for viewing opaque objects. We shall now proceed to describe the single microscope, which is used for transparent objects: but in order to examine these, the box HIKL must be first removed, and in its place we must insert the tube Y of the single microscope that we are now going to describe.

Micro-scope. Fig. 25

Fig. 25. represents a large tooth and pinion microscope: at *m*, within the body of this microscope, are two thin plates, that are to be separated in order to let the ivory sliders pass between them; they are pressed together by a spiral spring, which bears up the under plate, and forces it against the upper one.

The slider S (under fig. 4.), which contains the magnifiers, fits into the hole *n*; and any of the magnifiers may be placed before the object, by moving the aforesaid slider: when the magnifier is at the centre of the hole P, a small spring falls into one of the notches which is on the side of the slider.

Under the plate *m* are placed two lenses, for enlarging the field of view on the screen: the smaller of the two is fixed in a piece of brass, and is nearest the plate *m*; this is to be taken out when the magnifiers, N° 4, 5, or 6, are used, or when the megalascope lens T (fig. 24.) is used; but is to be replaced for N° 1, 2, 3.

This microscope is adjusted to the focus by turning the milled nut O.

To *use* the solar microscope:—Make a round hole in the window shutter, a little larger than the circle *a b c*; pass the mirror ONP through this hole, and apply the square plate to the shutter; then mark with a pencil the places which correspond to the two holes through which the screw is to pass; take away the microscope, and bore two holes at the marked places, sufficiently large to let the milled screws *d e* pass through them.

The screws are to pass from the outside of the shutter, to go through it: and being then screwed into their respective holes in the square plate, they will, when screwed home, hold it fast against the inside of the shutter, and thus support the microscope.

Screw the conical tube ABCD to the circle *a b c*, and then slide the tube G of the opaque box into the cylindrical part CDEF of the body, if opaque objects are to be examined; but if they be transparent objects you mean to show, then place the tube Y within the tube CDEF.

The room is to be darkened as much as possible, that no light may enter but what passes through the body of the microscope; for, on this circumstance, together with the brightness of the sunshine, the perfection and distinctness of the image in a great measure depend.

When the microscope is to be used for opaque objects, 1. Adjust the mirror NOP, so as to receive the solar rays, by means of the two finger screws or nuts, QR; the first, Q, turns the mirror to the right or left; the second, R, raises or depresses it: this you are to do till you have reflected the sun's light through the lens at AB strongly upon a screen of white paper placed at some distance from the window, and formed thereon a round spot of light. An unexperienced observer will find it more convenient to obtain the light by forming this spot before he puts on either the opaque box or the tooth and pinion microscope.

Now put in the *opaque* box, and place the object between the plates at H; open the door *i k*, and adjust the mirror M till you have illuminated the object strongly. If you cannot effect this by the screw S, you must move the screws Q, R, in order to get the light reflected strongly from the mirror NOP, or the mirror

Microscope.

mirror M, without which the latter cannot illuminate the object.

The object being strongly illuminated, shut the door *i k*, and a distinct view of the object will soon be obtained on your screen, by adjusting the tubes VX, which is effected by moving them backwards or forwards.

A round spot of light cannot always be procured in northern latitudes, the altitude of the sun being often too low; neither can it be obtained when the sun is directly perpendicular to the front of the room.

As the sun is continually changing its place, it will be necessary, in order to keep his rays full upon the object, to keep them continually directed through the axis of the instrument, by the two screws Q and R.

To view *transparent* objects, remove the opaque box, and insert the tube Y, fig. 25. in its place; put the slider S into its place at *n*, and the slider with the objects between the plates at *m*; then adjust the mirror NOP, as before directed by the screws Q, R, so that the light may pass through the object; regulate the focus of the magnifier by the screw O. The most pleasing magnifiers in use are the fourth and fifth.

The size of the object may be increased or diminished, by altering the distance of the screen from the microscope: five or six feet is a convenient distance.

To examine transparent objects of a larger size, or to render the instrument what is usually called a *megalascope*, take out the slider S from its place at *n*, and screw the button T (fig. 24.) into the hole at P, fig. 25. and remove the glass which is under the plate at *m*, and regulate the light and focus agreeable to the foregoing directions.

N. B. At the end of the tube G there is a lens for increasing the density of the rays, for the purpose of burning or melting any combustible or fusible substance: this lens must be removed in most cases, lest the objects should be burnt. The intensity of the light is also varied by moving this tube backwards or forwards.

Apparatus of the Opaque Solar Microscope.—The large square plate and mirror; the body of the microscope; the opaque box and its tube; the tooth and pinion microscope; the slider with the magnifiers; the megalascope magnifier; the two screws *d* and *e*; some ivory sliders; some sliders with opaque objects; a brass frame, with a bottom of soft deal to stick any object on; a brass cylinder K (fig. 31.), for confining opaque objects.

Plate CCCXLI.

IV. *The* Camera Obscura, *or* Lucernal, *Microscope.*

The great facility with which objects can be represented on paper or a rough glass in the camera obscura, and copies drawn from them by any person though unskilled in drawing, evidently suggested the application of the microscope to this instrument. The greatest number of experiments that appear to have been made with this view, were by Mr Martin and Mr Adams; the former of whom frequently applied the microscope to the portable camera, and with much effect and entertainment. But these instruments being found to answer only with the assistance of the sun, Mr Adams directed his experiments to the construction of an instrument of more extended utility, which could be equally employed in the day-time and by night. He accordingly succeeded so far as to produce, by *candle-light*, the images of objects refracted from a single magnifier upon one or two large convex lenses (of about five inches or upwards in diameter), at the end of a pyramidal shaped box, in a very pleasing and magnified appearance, so as to give opaque objects as well as transparent ones the utmost distinctness of representation; but still the light of a candle or lamp was found generally insufficient to throw the requisite degree of illumination upon the objects. The invention of what is called *Argand's lamp*, within these few years, offered a complete remedy for this defect, by the intensity and steadiness of its light. This did not escape Mr Adams (son of the former), who immediately applied it; and who had likewise so altered and improved his father's instrument, both in construction and form, as to render it altogether a different one, and far more perfect and useful.

Microscope.

The advantages and properties of this excellently conceived instrument are numerous and important. "As the far greater part of the objects which surround us are opaque (says our author), and very few are sufficiently transparent to be examined by the common microscopes, an instrument that could be readily applied to the examination of opaque objects has always been a desideratum. Even in the examination of transparent objects, many of the fine and more curious portions are lost, and drowned, as it were, in the light which must be transmitted through them; while different parts of the same object appear only as dark lines or spots, because they are so opaque as not to permit any light to pass through them. These difficulties, as well as many more, are obviated in the lucernal microscope; by which opaque objects of various sizes may be seen with ease and distinctness: the beautiful colours with which most of them are adorned, are rendered more brilliant, without changing in the least the real tint of the colour; and the concave and convex parts retain also their proper form.—The facility with which all opaque objects are applied to this instrument, is another considerable advantage, and almost peculiar to itself; as the texture and configuration of the more tender parts are often hurt by previous preparation, every object may be examined by this instrument, first as opaque, and afterwards (if the texture will admit of it) as transparent.—The lucernal microscope does not in the least fatigue the eye; the object appears like nature itself, giving ease to the sight and pleasure to the mind: there is also, in the use of this instrument, no occasion to shut the eye which is not directed to the object. A further advantage peculiar to this microscope is, that by it the outlines of every object may be taken, even by those who are not accustomed to draw; while those who can draw well will receive great assistance, and execute their work with more accuracy and in less time than they would otherwise have been able to have performed it. Transparent objects as well as opaque may be copied in the same manner. The instrument may be used at any time of the day, but the best effect is by night; in which respect it has a superiority over the solar microscope, as that instrument can only be used when the sun shines.

Transparent objects may be examined with the lucernal microscope in three or four different modes, from

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from a blaze of light almost too great for the eye to bear, to that which is perfectly easy to it: And by the addition of a tin lanthorn to the apparatus, may be thrown on a screen, and exhibited at one view to a large company, as by the solar microscope.

We shall now proceed to the description of the instrument and apparatus as given by Mr Adams.

Plate CCCXLI. fig. 26.

Fig. 26. represents the improved *Lucernal Microscope*, mounted to view opaque objects. ABCD is a large mahogany pyramidal box, which forms the body of the microscope; it is supported firmly on the brass pillar FG, by means of the socket H and the curved piece IK.

LMN is a guide for the eye, in order to direct it in the axis of the lenses; it consists of two brass tubes, one sliding within the other, and a vertical flat piece, at the top of which is the hole for the eye. The outer tube is seen at MN, the vertical piece is represented at LM. The inner tube may be pulled out, or pushed in, to adjust it to the focus of the glasses. The vertical piece may be raised or depressed, that the hole, through which the object is to be viewed, may coincide with the centre in the field of view; it is fixed by a milled screw from M, which could not be shown in this figure.

At N is a dove-tailed piece of brass, made to receive the dove-tail at the end of the tubes MN, by which it is affixed to the wooden box ABCDE. The tubes MN may be removed from this box occasionally, for the convenience of packing it up in a less compass.

OP, a small tube which carries the magnifiers.

O, one of the magnifiers; it is screwed into the end of a tube, which slides within the tube P; the tube P may be unscrewed occasionally from the wooden body.

QRSTVX, a long square bar, which passes through the sockets YZ, and carries the stage or frame that holds the objects; this bar may be moved backward or forward, in order to adjust it to the focus by means of the pinion which is at *a*.

b, A handle furnished with an universal joint, for more conveniently turning the pinion. When the handle is removed, the nut (fig. 27.) may be used in its stead.

Fig. 27.

d e, A brass bar, to support the curved piece KI, and keep the body AB firm and steady.

f g h i, The stage for opaque objects: it fits upon the bar QRST by means of the socket *h i*, and is brought nearer to or removed farther from the magnifying lens by turning the pinion *a*: the objects are placed in the front side of the stage (which cannot be seen in this figure) between four small brass plates; the edges of two of these are seen at *k l*. The two upper pieces of brass are moveable; they are fixed to a plate, which is acted on by a spiral spring, that presses them down, and confines the slider with the objects: this plate, and the two upper pieces of brass, are lifted up by the small nut *m*.

At the lower part of the stage, there is a semicircular lump of glass *n*, which is designed to receive the light from the lamp, fig. 29. and to collect and throw it on the concave mirror *o*, whence it is to be reflected on the object.

The upper part *f g h s* (fig. 26.) of the opaque stage takes out, that the stage for transparent objects may be inserted in its place.

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Fig. 28. represents the stage for transparent objects; the two legs 5 and 6 fit into the top of the under part *r s h i* of the stage for opaque objects; 7 is the part which confines or holds the sliders, and through which they are to be moved; 9 and 10, a brass tube, which contains the lenses for condensing the light, and throwing it upon the object; there is a second tube within that, marked 9 and 10, which may be placed at different distances from the object by the pin 11. Fig. 28.

When this stage is used as a single microscope, without any reference to the lucernal, the magnifiers or object lenses, are to be screwed into the hole 12, and to be adjusted to a proper focus by the nut 13.

N. B. At the end AB (fig. 26.) of the wooden body there is a slider, which is represented as partly drawn out at A: when quite taken out, three grooves will be perceived; one of which contains a board that forms the end of the box; the next contains a frame with a grayed glass; and the third, or that farthest from the end AB, two large convex lenses.

Fig. 29. represents one of Argand's lamps, which are most suitable for microscopic purposes, on account of the clearness, the intensity, and the steadiness of the light. The following account of the method of managing them, with other observations, is copied from an account given by Mr Parker with those he sells. Fig. 29.

The principle on which the lamp acts, consists in disposing the wick in thin parts, so that the air may come in contact with all the burning fuel; by which means, together with an increase of the current of air occasioned by rarefaction in the glass tube, the whole of the fuel is converted into flame.

The wicks are circular; and, the more readily to regulate the quantity of light, are fixed on a brass collar, with a wire handle, by means of which they are raised or depressed at pleasure.

To fix the wick on, a wooden mandril is contrived, which is tapered at one end, and has a groove turned at the other.

The wick has a selvage at one end, which is to be put foremost on the mandril, and moved up to the groove; then putting the groove into the collar of the wick-holder, the wick is easily pushed forward upon it.

The wick-holder and wick being put quite down in their place, the spare part of the wick should, while dry, be set a-light, and suffered to burn to the edge of the tubes; this will leave it more even than by cutting, and, being black by burning, will be much easier lighted: for this reason, the black should never be quite cut off.

The lamp should be filled an hour or two before it is wanted, that the cotton may imbibe the oil and draw the better.

The lamps which have a reservoir and valve, need no other direction for filling than to do it with a proper trimming pot, carefully observing when they are full; then pulling up the valve by the point, the reservoir, being turned with the other hand, may be replaced without spilling a drop.

Those lamps which fill in the front like a bird-fountain, must be reclined on the back to fill; and the

should

Micro-scope.

should be done gently, that the oil in the burner may return into the body when so placed and filled: if, by being too full, and oil appears above the guard, only move the lamp a little, and the oil will disappear; the lamp may then be placed erect, and the oil will flow to its proper level.

The oil must be of the spermaceti kind, commonly called chamber oil, which may generally be distinguished by its paleness, transparency, and inoffensive scent: all those oils which are of a red and brown colour, and of an offensive scent, should be carefully avoided, as their glutinous parts clog the lamp, and the impurities in such oil, not being inflammable, will accumulate and remain in the form of a crust on the wick. Seal oil is nearly as pale and sweet as chamber oil; but being of a heavy sluggish quality, is not proper for lamps with fine wicks.

Whenever bad oil has been used, on changing it, the wick must also be changed; because, after having imbibed the coarse particles in its capillary tubes, it will not draw up the fine oil.

To obtain the greatest degree of light, the wick should be trimmed exactly even, the flame will then be completely equal.

There will be a great advantage in keeping the lamp clean, especially the burner and air tubes; the neglect of cleanliness in lamps is too common: a candlestick is generally cleaned every time it is used, so should a lamp; and if a candlestick is not to be objected to because it does not give light after the candle is exhausted, so a lamp should not be thought ill of, if it does not give light when it wants oil or cotton: but this last has often happened, because the deficiency is less visible.

The glass tubes are best cleaned with a piece of wash-leather.

If a fountain lamp is left partly filled with oil, it may be liable to overflow: this happens by the contraction of the air when cold, and its expansion by the warmth of a room, the rays of the sun, or the heat of the lamp when re-lighted: this accident may be effectually prevented by keeping the reservoir filled, the oil not being subject to expansion like air. On this account, those with a common reservoir are best adapted for microscopic purposes.

To examine Opaque Objects, with the Lucernal Microscope. To render the use of this instrument easy, it is usually packed with as many of the parts together as possible: it occupies on this account rather more room, but is much less embarrassing to the observer, who has only three parts to put on after it is taken out of its box, namely, the guide for the eye, the stage, and the tube with its magnifier.

But to be more particular: Take out the wooden slider A (fig. 26.), then lift out the cover and the gray glass, from their respective grooves under the slider A.

Put the end N of the guide for the eye LMN into its place, so that it may stand in the position which is represented in this figure.

Place the socket which is at the bottom of the opaque stage, on the bar QXT, so that the concave mirror *o* may be next the end DE of the wooden body.

Screw the tubes PO into the end DE. The magnifier you intend to use is to be screwed on the end O of these tubes. Micro-scope.

The handle G *b*, or the milled nut, fig. 27. must be placed on the square end of the pinion *a*.

Place the lamp lighted before the glass lamp *n*, and the object you intend to examine between the spring plates of the stage; and the instrument is ready for use.

In all microscopes there are two circumstances which must be particularly attended to: first, the modification of the light, or the proper quantity to illuminate the object; secondly, the adjustment of the instrument to the focus of the glass and eye of the observer. In the use of the lucernal microscope there is a third circumstance, which is, the regulation of the guide for the eye.

1. To throw the light upon the object. The flame of the lamp is to be placed rather below the centre of the glass lamp *n*, and as near it as possible; the concave mirror *o* must be so inclined and turned as to receive the light from the glass lamp, and reflect it thence upon the object; the 'best situation' of the concave mirror and the flame of the lamp depends on a combination of circumstances, which a little practice will discover.

2. To regulate the guide for the eye, or to place the centre of the eye-piece L so that it may coincide with the focal point of the lenses and the axis of vision: Lengthen and shorten the tubes MN, by drawing out or pushing in the inner tube, and raising or depressing the eye-piece ML, till you find the large lens (which is placed at the end AB of the wooden body) filled by an uniform field of light, without any prismatic colours round the edge; for till this piece is properly fixed, the circle of light will be very small, and only occupy a part of the lens; the eye must be kept at the centre of the eye-piece L, during the whole of the operation; which may be rendered somewhat easier to the observer, on the first use of the instrument, if he hold a piece of white paper parallel to the large lens, removing it from or bringing it nearer to them till he find the place where a lucid circle, which he will perceive on the paper, is brightest and most distinct; then he is to fix the centre of the eye-piece to coincide with that spot; after which a very small adjustment will set it perfectly right.

3. To adjust the lenses to their focal distance. This is effected by turning the pinion *a*, the eye being at the same time at the eye-piece L. The gray glass is often placed before the large lenses, while regulating the guide for the eye, and adjusting for the focal distance.

If the observer, in the process of his examination of an object, advance rapidly from a shallow to a deep magnifier, he will save himself some labour by pulling out the internal tube at O.

The upper part *f g r s* of the stage is to be raised or lowered occasionally, in order to make the centre of the object coincide with the centre of the lens at O.

To delineate objects, the gray glass must be placed before the large lenses; the picture of the object will be formed on this glass, and the outline may be accurately taken by going over the picture with a pencil.

The

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The opaque part may be used in the daytime without a lamp, provided the large lenses at AB are screened from the light.

To use the Lucernal Microscope in the examination of Transparent Objects.—The instrument is to remain as before: the upper part *f g s* of the opaque stage must be removed, and the stage for transparent objects, represented at fig. 28. put in its place; the end 9 10 to be next the lamp.

Place the grayed glass in its groove at the end AB, and the objects in the slider-holder at the front of the stage; then transmit as strong a light as you are able on the object, which you will easily do by raising or lowering the lamp.

The object will be beautifully depicted on the gray glass; it must be regulated to the focus of the magnifier, by turning the pinion *a*.

The object may be viewed either with or without the guide for the eye. A single observer will see an object to the greatest advantage by using this guide, which is to be adjusted as we have described above. If two or three wish to examine the object at the same time, the guide for the eye must be laid aside.

Take the large lens out of the groove, and receive the image on the gray glass; in this case, the guide for the eye is of no use: if the gray glass be taken away, the image of the object may be received on a paper screen.

Take out the gray glass, replace the large lenses, and use the guide for the eye; attend to the foregoing directions, and adjust the object to its proper focus. You will then see the object in a blaze of light almost too great for the eye, a circumstance that will be found very useful in the examination of particular objects. The edges of the object in this mode will be somewhat coloured: but as it is only used in this full light for occasional purposes, it has been thought better to leave this small imperfection, than, by remedying it, to sacrifice greater advantages; the more so, as this fault is easily corrected, a new and interesting view of the object is obtained, by turning the instrument out of the direct rays of light, and permitting them to pass through only in an oblique direction, by which the upper surface is in some degree illuminated, and the object is seen partly as opaque, partly as transparent. It has been already observed, that the transparent objects might be placed between the slider-holders of the stage for opaque objects, and then be examined as if opaque.

Some transparent objects appear to the greatest advantage when the lens at 9 10 is taken away; as, by giving too great a quantity of light, it renders the edges less sharp.

The variety of views which may be taken of every object by means of the improved lucernal microscope, will be found to be of great use to an accurate observer: it will give him an opportunity of correcting or confirming his discoveries, and investigating those parts in one mode which are invisible in another. Micro-scope.

To throw the image of transparent objects on a screen as in the solar microscope.—It has been long a microscopical desideratum, to have an instrument by which the image of transparent objects might be thrown on a screen, as in the common solar microscope: and this not only because the sun is so uncertain in this climate, and the use of the solar microscope requires confinement in the finest part of the day, when time seldom hangs heavy on the mind; but as it also affords an increase of pleasure, by displaying its wonders to several persons at the same instant, without the least fatigue to the eye.

This purpose is now effectually answered, by affixing the transparent stage of the lucernal to a lanthorn, with one of Argand's lamps.—The lamp is placed within the lanthorn, and the end 9 10 of the transparent stage is screwed into a female screw, which is rivetted in the sliding part of the front of the lanthorn; the magnifying lenses are to be screwed into the hole represented at 12, and they are adjusted by turning the milled nut. The quantity of light is to be regulated by raising and lowering the sliding-plate or the lamp.

Apparatus which usually accompanies the improved Lucernal Microscope.—The stage for opaque objects, with its semicircular lump of glass, and concave mirror. The stage for transparent objects, which fits on the upper part of the foregoing stage. The sliding tube, to which the magnifiers are to be affixed: one end of these is to be screwed on the end D of the wooden body; the magnifier in use is to be screwed to the other end of the inner tube. Eight magnifying lenses: these are so constructed that they may be combined together, and thus produce a very great variety of magnifying powers. A fish-pan, such as is represented at I. A steel wire L, with a pair of nippers at one end, and a small cylinder of ivory *l* at the other. A slider of brass N, containing a flat glass slider, and a brass slider into which are fitted some small concave glasses. A pair of forceps. Six large and six small ivory sliders, with transparent objects. Fourteen wooden sliders, with four opaque objects in each slider; and two spare sliders. Some capillary tubes for viewing small animalcula.

Ingenious men seldom content themselves with an instrument under one form; hence such a variety of microscopes, hence many alterations in the Lucernal Microscope. Mr Adams himself, we understand, has fitted up this last in a great many different ways; and it is reasonable to think that no person was more likely to give it every improvement of which it is susceptible. Of the alterations by other hands we shall only particularize one, made by Mr Jones of Holborn (B), whose description is as follows:

A (fig. 30.) represents a portion of the top of the ma- Fig. 30. hogany

C

(B) We trust the reader will never consider any paragraph wherein the name of an instrument-maker or other artist is inserted, as a recommendation of those artists by the editors of this work. In the course of a pretty extensive correspondence, they have been favoured with very liberal communications from various artists, for which they are greatly indebted to them: the inserting their names in this work is therefore to be considered

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hogany box in which it packs, to preserve it steady; it slides in a dove-tail groove withinside, a similar groove to which is cut in the top of the box A; so that when the instrument is to be used, it is slipt out of the box withinside, and then slipt into the groove at top ready for use, almost instantly, as shown in the figure. The adjustment of the objects is at the stage E; for the right focal distance is readily and conveniently made by turning the long screw-rod BB, which goes through the two pillars supporting the box, and works in the base of the brass stage E; which base is also dove-tailed, so as to have a regular and steady motion in another brass basis that supports it. In this instrument, therefore, the pyramidical box does not move; but the stage part only, which, from its small weight, moves in the most agreeable and steady manner. While observing the image of the object upon the glass through the sight-hole at G, the object may be moved or changed by only turning the rack-work and pinion applied to the stage by means of the handle D, for that purpose. By this contrivance you have no occasion to change your position during the view of the objects upon one of the sliders. This motion changes the objects horizontally only; and as they are generally placed exactly in one line, it answers all the purposes for which this motion is intended very well. But it may sometimes happen that the observer would wish to alter the vertical position of the object; to perform which there is another plain rod at F, that acts simply as a lever for this purpose, and moves the sliding part of the stage E vertically either upwards or downwards.

Thus, without altering his position, the observer may investigate all parts of the objects in the most satisfactory manner. Rack-work and pinion might be applied to the stage for the vertical motion also; but as it would materially enhance the expence, it is seldom applied. The brass work at the handle of D contains a Hooke's universal joint.

The brilliancy of the images of the objects shown upon the large lenses at the end of the box, being very frequently so great as to dazzle the eyes, Mr Jones applies a slight tinge of blue, green, and other coloured glass, to the sight-hole at G, which softens this glare, and casts an agreeable hue upon the objects.

Description of those Parts of a Microscopical Apparatus, common to most Instruments, which are delineated at fig. 31.

A and B represent the brass cells which contain the magnifiers belonging to the different kinds of compound microscopes. The magnifiers are sometimes contained in a slider like that which is delineated at S (fig. 24.). The lenses of A and B are confined by a small cap; on unscrewing this, the small lens may be taken out and cleaned. The magnifiers A of the lucernal microscope are so contrived, that any two of them may be screwed together, by which means a considerable variety of magnifying powers is obtained.

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To get at the lenses in the slider S (fig. 24.) take out the two screws which hold on the cover.

C represents the general form of the slider-holder. It consists of a cylindrical tube, in which an inner tube is forced up by a spring. It is used to receive the ivory or any other slider, in which the transparent objects are placed; these are to be slid between the two upper plates: the hollow part in one of the plates is designed for the glass tubes.

D, the condensing lens and its tube, which fits into the slider-holder C, and may be moved up and down in it. When this piece is pushed up as far as it will go, it condenses the light of a candle, which is reflected on it by the plain mirror of the compound microscope, and spreads it uniformly over the object; in this case it is best adapted to the shallowest magnifiers. If the deeper lenses are used, it should be drawn down, or rather removed further from the object, that it may concentrate the light in a small compass, and thus render it more dense. The condensing lens is sometimes fitted up differently; but the principle being the same, it will be easy to apply it to use notwithstanding some variations in the mechanism.

E, a brass cone. It fixes under the slider-holder, and is used to lessen occasionally the quantity of light which comes from the mirror to any object.

F, a box with two flat glasses, which may be placed at different distances from each other in order to confine a small living insect.

G, a small brass box to hold the silver speculum H.

H, a small silver concave speculum, designed to reflect the light from the mirror on opaque objects; it should only be used with the shallow magnifiers. It is applied in different ways to the compound microscope; sometimes to a tube similar to that represented at X, which slides on the lower part of the body; sometimes it is screwed into the ring of the piece Q; the pin of this generally fits into one of the holes in the stage. When this speculum is used, the slider-holder should be removed.

I, a fish-pan, whereon a small fish may be fastened, in order to view the circulation of the blood: its tail is to be spread across the oblong hole at the smallest end, and tied fast by means of the ribbon fixed thereto, by shoving the knob which is on the back of it through the slit made in the stage; the tail of the fish may be brought under the lens which is in use.

K, a cylindrical piece, intended for the solar opaque microscope; by pulling back the spiral spring, smaller or larger objects may be confined in it.

k, A pair of triangular nippers for taking hold of and confining a large object.

L, a long steel wire, with a small pair of pliers at one end and a steel point at the other: the wire slips backwards or forwards in a spring tube, which is affixed to a joint, at the bottom of which is a pin to fit one

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as a grateful acknowledgment from the editors for favours conferred on them,—not as a testimonial of their opinion of the abilities of an individual, or as designed to insinuate any preference over others in the same line, where such preference has not been already bestowed by the public.

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one of the holes in the stage; this piece is used to confine small objects.

l, A small ivory cylinder that fits on the pointed end of the steel wire L; it is designed to receive opaque objects. Light-coloured ones are to be stuck on the dark side, and *vice versa*.

M, a convex lens, which fits to the stage by means of the long pin adhering to it. This piece is designed to collect the light from the sun or a candle, and to throw them on any object placed on the stage; but it is very little used at present.

N, a brass slider, into which is fitted a flat piece of glass, and a brass slider containing four small glasses, one or two of them concave, the others flat; it is designed to confine small living objects, and when used is to be placed between the two upper plates of the slider-holder.

O, a glass tube to receive a small fish, &c.

P, represents one of the ivory sliders, wherein objects are placed between two pieces of talc, and confined by a brass ring.

Q, a piece to hold the speculum H: this piece is generally fitted to the microscope represented at fig. 12.

R, a pair of forceps, to take up any occasional object.

S, a camel's hair pencil to brush the dust off the glasses; the upper part of the quill is scooped out, to take up a drop of any fluid, and place it on either of the glasses for examination.

T, an instrument for cutting thin transverse sections of wood. It consists of a wooden base, which supports four brass pillars; on the top of the pillars is placed a flat piece of brass, near the middle of which there is a triangular hole.

A sharp knife, which moves in a diagonal direction, is fixed on the upper side of the afore-mentioned plate, and in such a manner that the edge always coincides with the surface thereof.

The knife is moved backwards and forwards by means of the handle *a*. The piece of wood is placed in the triangular trough which is under the brass plate, and is to be kept steady therein by a milled screw which is fitted to the trough; the wood is to be pressed forward for cutting by the micrometer screw *b*.

The pieces of wood should be applied to this instrument immediately on being taken out of the ground, or else they should be soaked for some time in water, to soften them so that they may not hurt the edge of the knife.

When the edge of the knife is brought in contact with the piece of wood, a small quantity of spirits of wine should be poured on the surface of the wood, to prevent its curling up; it will also make it adhere to the knife, from which it may be removed by pressing a piece of blotting paper on it.

y, An appendage to the cutting engine, which is to be used instead of the micrometer screw, being preferred to it by some. It is placed over the triangular hole, and kept flat down upon the surface of the brass plate, while the piece of wood is pressed against a circular piece of brass which is on the under side of it. This circular piece of brass is fixed to the screw, by which its distance from the flat plate on which the knife moves may be regulated.

z, An ivory box, containing at one end spare talc for the ivory slider, and at the other spare rings for pressing the tales together and confining them to the slider. Micro-scope.

Fluid microscopes have been also proposed; the first, it would appear, was suggested by Mr Grey. This was formed of water, and an account of it will be found in N° 221, 223, Phil. Trans. An improved microscope, on a similar principle, has been invented by Mr Brewster, of which the following is a description, taken from a note by the translator of Haüy's Natural Philosophy.

"A vertical bar (says Mr Gregory), is fixed upon a horizontal pedestal; and from the top of this bar proceeds a horizontal arm, which supports a circular case containing the lenses; below this another horizontal arm slides up and down, capable of adjustment by means of a screw, and carrying the usual sliders to hold the object which it is proposed to examine; and upon the pedestal is fixed the frame of a mirror, which has both an inclined and a horizontal motion, in order to illuminate any object upon the slider. The upper circular case is hollow, and contains four or more plano-convex lenses, which are constituted each of a drop of very pure and viscid turpentine varnish, taken up by the point of a piece of wood, and dropped upon a piece of very thin and well polished glass. The lenses thus formed may be made of any focal length by taking up a greater or a less quantity of fluid. The lower surface of the glass having been first smoked with a candle, the black pigment immediately below the lenses is then to be removed, so that no light may pass but through the lenses. The piece of glass is then perforated at its centre, and surrounded by a toothed wheel, which, when the wheel is put in the upper circular screw, may be turned by a common endless screw, so that the fluid lenses shall be brought severally under an eye-aperture properly disposed, and any object be successfully examined with a variety of magnifying powers." Note, p. 365. See also Ferguson's Lectures by Brewster, vol. ii.

AFTER what has been related of microscopes, they cannot be said to be complete without the valuable addition of a *micrometer*; for the use and advantages of which, see the article MICROMETER.

HAVING presented our readers with descriptions of the various microscopes generally used, we think it our duty to point out to them those which we conceive to be best calculated to answer the purposes of science. The first which presents itself to our mind is that of *Ellis*: It is better adapted than any other portable microscope, to the purpose of general observation; simple in its construction, and general in its application. To those who prefer a double microscope, we should recommend that figured in Plate CCCXXXVIII. fig. 12. If opaque objects, as insects, &c. be subjects of investigation, the *Lucernal Microscope* claims the preference; but if amusement alone guides the choice, the *Solar Microscope* must be fixed upon.

WE shall now proceed to explain some necessary particulars respecting the method of using microscopes; after which, we shall subjoin an enumeration of the principal

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tical objects discovered or elucidated by their means. On this subject Mr Adams, in his *Essay on the Microscope*, has been very copious; with a view, as he informs us, to remove the common complaint made by Mr Baker, "that many of those who purchase microscopes are so little acquainted with their general and extensive usefulness, and so much at a loss for objects to examine by them, that after diverting their friends some few times with what they find in the sliders which generally accompany the instrument, or perhaps with two or three common objects, the microscope is laid aside as of little further value: whereas no instrument has yet appeared in the world capable of affording so constant, various, and satisfactory an entertainment to the mind."

I. In using the microscope, there are three things necessary to be considered. (1.) The preparation and adjustment of the instrument itself. (2.) The proper quantity of light, and the best method of directing it to the object. (3.) The method of preparing the objects, so that their texture may be properly understood.

1. With regard to the microscope itself, the first thing necessary to be examined is, whether the glasses be clean or not: if they are not so, they must be wiped with a piece of soft leather, taking care not to soil them afterwards with the fingers: and, in replacing them, care must be taken not to place them in an oblique situation. We must likewise be careful not to let the breath fall upon the glasses, nor to hold that part of the body of the instrument where the glasses are placed with a warm hand, because thus the moisture expelled by the heat from the metal will condense upon the glass, and prevent the object from being distinctly seen. The object should be brought as near the centre of the field of view as possible; for there only it will be exhibited in the greatest perfection. The eye should be moved up and down from the eye-glass of a compound microscope, till the situation is found where the largest field and most distinct view of the object are to be had: but every person ought to adjust the microscope to his own eye, and not to depend upon the situation it was placed in by another. A small magnifying power should always be begun with: by which means the observer will best obtain an exact idea of the situation and connexion of the whole: and will of consequence be less liable to form any erroneous opinion when the parts are viewed separately by a lens of greater power. Objects should also be examined first in their most natural position: for if this be not attended to, we shall be apt to form very inadequate ideas of the structure of the whole, as well as of the connexion and use of the parts. A living animal ought to be as little hurt or discomposed as possible.

From viewing an object properly, we may acquire a knowledge of its nature: but this cannot be done without an extensive knowledge of the subject, much patience, and many experiments: as in a great number of cases the images will resemble each other, though derived from very different substances. Mr Baker therefore advises us not to form an opinion too rashly after viewing a microscopical object: but to have our inferences the result of repeated experiments and examinations of the subject in many different lights and positions; so that no judgment upon things exhibited by force, or contracted by dryness, or in any manner out of a natural state, without making suitable allowances. The true colour of objects cannot be properly determined by very great magnifiers; for as the pores and interstices of an object are enlarged according to the magnifying power of the glasses made use of, the component particles of its substance will appear separated many thousand times farther asunder than they do to the naked eye: hence the reflection of the light from these particles will be very different, and exhibit different colours. It is likewise somewhat difficult to observe opaque objects: and as the apertures of the larger magnifiers are but small, they are not proper for the purpose. If an object be so very opaque, that no light will pass through it, as much as possible must be thrown upon the upper surface of it. Some consideration is likewise necessary in forming a judgment of the motion of living creatures, or even of fluids, when seen through the microscope: for as the moving body, and the space wherein it moves, are magnified, the motion will also be increased.

2. On the management of the light depends in a great measure the distinctness of the vision: and as, in order to have this in the greatest perfection, we must adapt the quantity of light to the nature of the object and the focus of the magnifier, it is therefore necessary to view it in various degrees of light. In some objects, it is difficult to distinguish between a prominence and a depression, a shadow or a black stain: or between a reflection of light and whiteness, which is particularly observable in the eye of the libellula and other flies: all of these appearing very different in one position from what they do in another. The brightness of an object likewise depends on the quantity of light, the distinctness of vision, and on regulating the quantity to the object: for some will be in a manner lost in a quantity of light scarcely sufficient to render another visible.

There are various ways in which a strong light may be thrown upon objects: as by means of the sun and a convex lens. For this purpose, the microscope is to be placed about three feet from a southern window; then take a deep convex lens, mounted on a semicircle and stand, so that its position may easily be varied: place this lens between the object and the window, so that it may collect a considerable number of solar rays, and refract them on the object or the mirror of the microscope. If the light thus collected from the sun be too powerful, it may be lessened by placing a piece of white paper, or a piece of glass highly grazed, between the object and lens. Thus a proper degree of light may be obtained, and diffused equally all over the surface of an object: a circumstance which ought to be particularly attended to: for if the light be thrown unequally upon it, no distinct view can be obtained. If we mean to make use of the solar light, it will be found convenient to darken the room, and to reflect the rays of the sun on the above-mentioned lens by means of the mirror of a solar microscope fixed to the window-shutter: for thus the observer will be enabled to preserve the light on his object, notwithstanding the motion of the sun. But by reason of this motion, and the various state of the atmosphere, solar observations are rendered both tedious and inconvenient: whence it will be proper for the observer to be

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be furnished with a large tin lanthorn, formed something like the common magic lanthorn, capable of containing one of Argand's lamps. This, however, ought not to be of the fountain kind, lest the rarefaction of the air in the lanthorn should force the oil over. There ought to be an aperture in the front of the lanthorn, which may be moved up and down, and be capable of holding a lens; by which means a pleasant and uniform as well as strong light may easily be procured. The lamp should likewise move on a rod, so that it may be easily raised or depressed. This lanthorn may likewise be used for many other purposes; as viewing of pictures, exhibiting microscopic objects on a screen, &c. A weak light, however, is best for viewing many transparent objects: among which we may reckon the prepared eyes of flies, as well as the animalcules in fluids. The quantity of light from a lamp or candle may be lessened by removing the microscope to a greater distance from them, or by diminishing the strength of the light which falls upon the objects. This may very conveniently be done by pieces of black paper with circular apertures of different sizes, and placing a larger or smaller one upon the reflecting mirror, as occasion may require. There is an oblique situation of the mirrors, which makes likewise an oblique reflection of the light easily discovered by practice, (but for which no general rule can be given in theory); and which will exhibit an object more distinctly than any other position, showing the surface, as well as those parts through which the light is transmitted. The light of a lamp or candle is generally better for viewing microscopic objects than day light; it being more easy to modify the former than the latter, and to throw it upon the objects with different degrees of density.

3. Swammerdam has excelled in the preparation of objects almost all other investigators. Neither difficulty nor disappointment could make him abandon the pursuit of any object until he had obtained a satisfactory idea of it. But unhappily the methods he used in preparing his objects for the microscope are now entirely unknown. Boerhaave examined with the strictest attention all the letters and manuscripts of Swammerdam which he could find; but his researches were far from being successful. The following are all the particulars, which have thus come to the knowledge of the public.

For dissecting *small insects*, Swammerdam had a brass table made by S. Muschenbroeck, to which were affixed two brass arms moveable at pleasure to any part of it: The upper part of these vertical arms was constructed in such a manner as to have a slow vertical motion; by which means the operator could readily alter their height as he saw convenient. One of these arms was to hold the minute objects, and the other to apply the microscope.

The lenses of Swammerdam's microscopes were of various sizes as well as foci: but all of them the best that could be procured, both for the transparency of the glass and the fineness of the workmanship. His observations were always begun with the smallest magnifiers, from which he proceeded to the greatest; but in the use of them, he was so exceedingly dexterous, that he made every observation subservient to that which succeeded it, and all of them to the confirmation of each other, and to the completing of the description. His chief art seems to have been in constructing scissars of an exquisite fineness, and making them very sharp. Thus he was enabled to cut very minute objects to much more advantage than could be done by knives and lancets; for these, though ever so sharp and fine, are apt to disorder delicate substances by displacing some of the filaments, and drawing them after them as they pass through the bodies; but the scissars cut them all equally. The knives, lancets, and styles he made use of in his dissections, were so fine that he could not see to sharpen them without the assistance of a magnifying glass; but with these he could dissect the intestines of bees with the same accuracy that the best anatomists can do those of large animals. He made use also of very small glass tubes no thicker than a bristle, and drawn to a very fine point at one end, but thicker at the other. These were for the purpose of blowing up, and thus rendering visible, the smallest vessels which could be discovered by the microscope; to trace their courses and communications, or sometimes to inject them with coloured liquors.

Swammerdam sometimes made use of spirit of wine, water, or oil of turpentine, for suffocating the insects he wished to examine; and would preserve them for a time in these liquids. Thus he kept the parts from putrefying, and gave them besides such additional strength and firmness, as rendered the dissections much more easy than they would otherwise have been. Having then divided the body transversely with the scissars, and made what observations he could without farther dissection, he proceeded to extract the intestines carefully with very fine instruments, to wash away the fat in the like careful manner; and thus to put the parts into such a state as would best expose them to view; but these operations are best performed while the insects are in their nympha state.

Sometimes the delicate viscera of the insects, after having been suffocated as above mentioned, were put into water: after which, having shaken them gently, he procured an opportunity of examining them, especially the air vessels, which last he could thus separate entire from all the other parts, to the admiration of all who beheld them: as these vessels cannot be distinctly seen in any other manner, or indeed in any way whatever, without injuring them. Frequently also he injected water with a syringe to cleanse the parts thoroughly, after which he blew them up with air and dried them; thus rendering them durable, and fit for examination at a proper opportunity. Sometimes he made very important discoveries, by examining insects which he had preserved for several years in balsam. Other insects he punctured with a very fine needle; and after squeezing out all their moisture through the holes made in this manner, he filled them with air, by means of very slender glass tubes; then dried them in the shade; and lastly, anointed them with oil of spike in which a little rosin had been dissolved; and by which means they for a long time retained their proper forms. He was likewise in possession of a singular secret, by which he could preserve the limbs of insects as limber and perspicuous as ever they had been. He used to make a small puncture or incision in the tails of worms;

Microscope. worms; and after having with great caution squeezed out all the humours, as well as great part of the viscera, he injected them with wax in such a manner as to give them the appearance of living creatures in perfect health. He found that the fat of all insects was entirely dissolvable in oil of turpentine; by which means he was enabled plainly to discern the viscera; though, after this dissolution, it was necessary to cleanse and wash them frequently in clean water. In this manner he would frequently have spent whole days in the preparation of a single caterpillar, and cleansing it from its fat, in order to discover the true situation of the insect's heart. He had a singular dexterity in stripping off the skins of caterpillars that were on the point of spinning their cones. This was done by letting them drop by their threads into scalding water, and then suddenly withdrawing them. Thus the epidermis peeled off very easily; and, when this was done, he put them into distilled vinegar and spirit of wine mixed together in equal proportions; which, by giving a due degree of firmness to the parts, gave him an opportunity of separating them with very little trouble from the exuviæ, without any danger to the internal parts. Thus the nympha could be shown to be wrapped up in the caterpillar and the butterfly in the nympha; and there is little doubt that those who look into the works of Swammerdam, will be amply recompensed, whether they consider the unexampled labour or the piety of the author.

M. Lyonet, an eminent naturalist, usually drowned the insects he designed to examine; by which means he was enabled to preserve both the softness and transparency of the parts. According to him, the insect, if very small, viz. one-tenth of an inch, or little more, in length, should be dissected on a glass somewhat concave. If it should be suspected that the insect will putrefy by keeping for a few days, spirit of wine diluted with water must be substituted instead of pure water. The insect must be suffered to dry; after which it may be fastened by a piece of soft wax, and again covered with water.—Larger objects should be placed in a trough of thin wood; and for this purpose the bottom of a common chip box will answer very well; only surrounding the edge of it with soft wax, to keep in the water or other fluid employed in preserving the insect. The body is then to be opened: and if the parts are soft like those of a caterpillar, they should be turned back, and fixed to the trough by small pins, which ought to be set by a small pair of nippers. At the same time, the skin being stretched by another pair of finer forceps, the insect must be put into water, and dissected therein, occasionally covering it with spirit of wine. Thus the subject will be preserved in perfection, so that its parts may be gradually unfolded, no other change being perceived than that the soft elastic parts become stiff and opaque, while some others lose their colour.

The following instruments were made use of by M. Lyonet in his dissection of the *Chenille de Saule*. A pair of scissars as small as could be made, with long and fine arms: A pair of forceps, with their ends so nicely adjusted, that they could easily lay hold of a spider's thread, or a grain of sand: Two fine steel needles fixed in wooden handles, about two inches and three quarters in length; which were the most generally useful instruments he employed. Microscope.

Dr Hooke, who likewise made many microscopic observations, takes notice, that the common ant or pismire is much more troublesome to draw than other insects, as it is extremely difficult to get the body in a quiet natural posture. If its feet be fettered with wax or glue, while the animal remains alive, it so twists its body, that there is no possibility of gaining a proper view of it; and if it be killed before any observation is made, the shape is often spoiled before it can be examined. The bodies of many minute insects, when their life is destroyed, instantly shrivel up; and this is observable even in plants as well as insects, the surface of these small bodies being affected by the least change of air; which is particularly the case with the ant. If this creature, however, be dropped into rectified spirit of wine, it will instantly be killed; and when it is taken out, the spirit of wine evaporates, leaving the animal dry, and in its natural posture, or at least in such a state, that it may easily be placed in whatever posture we please.

Parts of Insects. The *wings*, in many insects, are so transparent, that they require no previous preparation: but some of those that are folded up under *elytra* or cases, require a considerable share of dexterity to unfold them; for these wings are naturally endowed with such a spring, that they immediately fold themselves again, unless care be taken to prevent them. The wing of the earwig, when expanded, is of a tolerable size, yet is folded up under a case not one-eighth part of its bulk; and the texture of this wing renders it difficult to be unfolded. This is done with the least trouble immediately after the insect is killed. Holding then the creature by the thorax, between the finger and the thumb, with a blunt-pointed pin endeavour gently to open it, by spreading it over the forefinger, and at the same time gradually sliding the thumb over it. When the wing is sufficiently expanded, separate it from the insect by a sharp knife or a pair of scissars. The wing should be pressed for some time between the thumb and finger before it be removed; it should then be placed between two pieces of paper, and again pressed for at least an hour, after which time, as there will be no danger of its folding up any more, it may be put between the tales, and applied to the microscope. Similar care is requisite in displaying the wings of the notonecta and other water insects, as well as most kinds of grylli.

The minute *scales* or *feathers*, which cover the wings of moths or butterflies, afford very beautiful objects for the microscope. Those from one part of the wing frequently differ in shape from such as are taken from other parts; and near the thorax, shoulder, and on the fringes of the wings, we generally meet with hair instead of scales. The whole may be brushed off the wing, upon a piece of paper, by means of a camel's hair pencil; after which the hairs can be separated with the assistance of a common magnifying glass.

It is likewise a matter of considerable difficulty to dissect properly the *proboscis* of insects, such as the gnat, tabanus, &c. and the experiment must be repeated a great number of times before the structure and situation

Microscope.

tuation of the parts can be thoroughly investigated, as the observer will frequently discover in one what he could not in another. The *collector of the bee*, which forms a very curious object, ought to be first carefully washed in spirit of turpentine; by which means it will be freed from the unctuous matter adhering to it: when dry, it is again to be washed with a camel's hair pencil to disengage and bring forward the small hairs which form part of this microscopic beauty. The best method of managing the *stings* of insects, which are in danger of being broken by reason of their hardness, is to soak the case and the rest of the apparatus for some time in spirit of wine or turpentine; then lay them on a piece of paper, and with a blunt knife draw out the sting, holding the sheath with the nail of the finger or any blunt instrument; but great care is necessary to preserve the *feelers*, which when cleaned add much to the beauty of the object. The *beard* of the lepas anatifera is to be soaked in clean soft water, frequently brushing it while wet with a camel's hair pencil: after it is dried, the brushing must be repeated with a dry pencil to disengage and separate the hairs, which are apt to adhere together.

To view to advantage the *fat*, *brains*, and other similar substances, Dr Hooke advises to render the surface smooth, by pressing it between two plates of thin glass, by which means the matter will be rendered much thinner and more transparent: without this precaution, it appears confused, by reason of the parts lying too thick upon one another. For *muscular fibres*, take a piece of the flesh, thin and dry; moisten it with warm water, and after this is evaporated the vessels will appear more plain and distinct; and by repeated macerations they appear still more so. The *exuviæ* of insects afford a pleasing object, and require but little preparation. If bent or curled up, they will become so relaxed by being kept a few hours in a moist atmosphere, that you may easily extend them to their natural positions; or the steam of warm water will answer the purpose very well.

The *eyes* of insects in general form very curious and beautiful objects. Those of the libellula and other flies, as well as of the lobster, &c. must first be cleaned from the blood, &c. after which they should be soaked in water for some days: one or two skins are then to be separated from the eye, which would be otherwise too opaque and confused; but some care is requisite in this operation; for if the skin be rendered too thin, it is impossible to form a proper idea of the organization of the part. In some substances, however, the organization is such, that by altering the texture of the part, we destroy the objects which we wish to observe. Of this sort are the nerves, tendons, muscular fibres, many of which are viewed to most advantage when floating in some transparent fluid. Thus very few of the muscular fibres can be discovered when we attempt to view them in the open air, though great numbers may be seen if they be placed in water or oil. By viewing the thread of a ligament in this manner, we find it composed of a vast number of smooth round threads lying close together. Elastic objects should be pulled or stretched out while they are under the microscope, that the texture and nature of those parts, the figure of which is altered by being thus pulled out, may be more fully discovered.

Other objects. To examine *bones* by the microscope, they should first be viewed as opaque objects: but afterwards, by procuring thin slices of them, they may be viewed as transparent. The sections should be cut in all directions, and be well washed and cleaned; and in some cases maceration will be useful, or the bones may be heated red hot in a clear fire, and then taken out; by which means the bony cells will appear more conspicuous. The *pores of the skin* may be examined by cutting off a thin slice of the upper skin with a razor, and then a second from the same place; applying the latter to the microscope. The lizard, guana, &c. have two skins, one very transparent, the other thicker and more opaque; and, separating these two, you obtain very beautiful objects.

Microscope.

To view the *scales of fish* to advantage, they ought to be soaked in water for a few days, and then carefully rubbed to clean them from the skin and dirt which may adhere to them. The scales of the eel are a great curiosity; and the more so, as this creature was not known to have any scales till they were discovered by the microscope. The method of discovering them is this. Take a piece of the skin of an eel from off its side, and spread it while moist on a piece of glass, that it may dry very smooth: when thus dried, the surface will appear all over dimpled or pitted by the scales, which lie under a sort of cuticle or thin skin; which may be raised with the sharp point of a penknife, together with the scales, which will then easily slip out; and thus we may procure as many as we please.

The *leaves* of many *trees*, as well as of some plants, when dissected, form a very agreeable object. In order to dissect them, take a few of the most perfect leaves you can find, and place them in a pan with clean water. Let them remain there three weeks, or a month, without changing the water: then take them up; and if they feel very soft, and almost rotten, they are sufficiently soaked. They must then be laid on a flat board, and holding them by the stalk, draw the edge of a knife over the upper side of the leaf, which will take off most of the skin. Then turn the leaf, and do the same with the under side; and when the skin is taken off on both sides, wash out the pulpy matter, and the fibres will be exhibited in a very beautiful manner. The leaf may be slit into two parts, by splitting the stalk; and the skins peeled from the fibres will also make a good object. This operation is best performed in the autumn; the fibres of the leaves are much stronger at that season, and less liable to be broken.—The internal structure of shells may be observed by grinding them down on a hone: and all ores and minerals should be carefully washed and brushed with a small brush, to remove any sordes that may adhere to them.

To view the *circulation of the blood*, we must observe living animals of the most transparent kind.—A small eel is sometimes used for this purpose; in which case it must be cleansed from the slime naturally adhering to it; after which it may be put into a tube filled with water, were it can be viewed in a satisfactory manner. The tail of any other small fish may be viewed in the same manner, or put upon a [illegible] flat glass, and thus laid before the microscope, by filling the tube with water when an eel

Microscope.

we prevent in a great measure the sliminess of the animal from soiling the glass.

The particles of the blood form a very curious object, and have been carefully viewed by different philosophers; who, nevertheless, differ from one another very much in their accounts of them. The best method of viewing these is to take a small drop of blood when warm, and spread it as thin as possible upon a flat piece of glass. By diluting it a little with warm water, some of the large globules will be separated from the smaller, and many of them subdivided; or a small drop of blood may be put into a capillary glass tube, and then placed before the microscope. Mr Baker advises warm milk as proper to be mixed with the blood; but Mr Hewson diluted the blood with its own serum: and by this method he could preserve the small particles entire, and view them distinctly; and thus he found that they were not globular, as had been imagined by other anatomists, but flat. Having shaken a piece of the crassamentum of the blood in serum till the latter became a little coloured, he spread it with a soft hair pencil on a piece of thin glass, which he placed under the microscope, in such a manner as not to be quite horizontal, but rather higher at one end than the other. Thus the serum flows from the higher to the lower part; and, as it flows, some of the particles will be found to swim on their flat sides, and will appear to have a dark spot in the middle; while others will turn over from one side to the other as they roll down the glass. Many cruel experiments have been tried in order to observe the circulation of the blood in living creatures, and an apparatus had been invented for viewing the circulation in the mesentery of a frog; but as this can answer no useful purpose, and will never be put in practice by persons of humanity, we forbear to mention it.

II. Besides the objects for the microscope already mentioned, there are innumerable others, some hardly visible, and others totally invisible, to the naked eye; and which therefore, in a more peculiar sense, are denominated.

Microscopic Animals. They are the animalcules or moving bodies in water, in which certain substances have been infused; and of which there are a great many different kinds. These animaleula are sometimes found in water which we would call *pure*, did not the microscope discover its minute inhabitants; but not equally in all kinds of water, or even in all parts of the same kind of it. The surfaces of infusions are generally covered with a scum which is easily broken, but acquires thickness by standing. In this scum the greatest number of animalcules are usually found. Sometimes it is necessary to dilute the infusions; but this ought always to be done with water, not only distilled, but viewed through a microscope, lest it should also have animalcules in it, and thus prove a source of deception. It is, however, most proper to observe those minute objects after the water is a little evaporated; the attention being less diverted by a few objects than when they appear in great number. One or two of the animalcules may be separated from the rest by placing a small drop of water on the glass near that of the infusion; join them together by making a small connexion between them with a pin; and as soon as you perceive that an animalcule has entered the clear drop, cut off the connexion again.

Microscope.

Eels in paste are obtained by boiling a little flour and water into the consistence of bookbinders paste; then exposing it to the air in an open vessel, and beating it frequently together to keep the surface from growing mouldy or hard. In a few days it will be found peopled with myriads of little animals visible to the naked eye, which are the eels in question. They may be preserved for a whole year by keeping the paste moistened with water; and while this is done, the motion of the animals will keep the surface from growing mouldy. Mr Baker directs a drop or two of vinegar to be put into the paste now and then. When they are applied to the microscope, the paste must be diluted in a piece of water for them to swim in.

Numberless animalcules are observed by the microscope in infusions of pepper. To make an infusion for this purpose, bruise as much common black pepper as will cover the bottom of an open jar, and lay it thereon about half an inch thick: pour as much soft water into the vessel as will rise about an inch above the pepper. Shake the whole well together: after which they must not be stirred, but be left exposed to the air for a few days; in which time a thin pellicle will be formed on the surface, in which innumerable animals are to be observed by the microscope.

The microscopic animals are so different from those of the larger kinds, that scarce any sort of analogy seems to exist between them; and one would almost be tempted to think that they lived in consequence of laws directly opposite to those which preserve ourselves and other visible animals in existence. They have been systematically arranged by O. F. Muller; though it is by no means probable that all the different classes have yet been discovered. Such as have been observed, however, are by this author divided in the following manner:

I. *Such as have no external organs.*

1. Monas: Punctiforme. A mere point.
2. Proteus: Mutabilis. Mutable.
3. Volvox: Sphæricum. Spherical.
4. Enchelis: Cylindracea. Cylindrical.
5. Vibrio: Elongatum. Long.

* Membranaceous.

6. Cyclidium: Ovale. Oval.
7. Paramecium: Oblongum. Oblong.
8. Kolpoda: Sinuatum. Sinuous.
9. Gonium: Angulatum. With angles.
10. Bursaria. Hollow like a purse.

II. *Those that have external organs.*

* Naked, or not enclosed in a shell.

1. Cercaria: Caudatum. With a tail.
2. Trichoda: Crinitum. Hairy.
3. Kerona: Cornicnlatum. With horns.
4. Himantopus: Cirratum. Cirrated.
5. Lencophra: Ciliatum undique. Every part ciliated.
6. Vorticella: Ciliatum apice. The apex ciliated.

* Covered with a shell.

7. Brachionus: Ciliatum apice. The apex ciliated.

In

Microscope.

In the treatise on HELMINTHOLOGY under the fifth order of the class vermes, viz. *Infusoria*, the genera here enumerated have already been noticed according to an arrangement somewhat different, and a few of the species have been described. For the sake of those who wish to prosecute microscopical inquiries, we shall introduce descriptions of a few more, and particularly those whose habitats are known.

I. *Monas.*

This is by our author defined to be "an invisible (to the naked eye), pellucid, simple, punctiform worm;" but of which, small as it is, there are several species.

The *monas terma* or *gelatinosa*, is a small jelly-like point, which can be but imperfectly seen by the single microscope, and not at all by the compound one. In a full light they totally disappear, by reason of their transparency. Some infusions are so full of them that scarce the least empty space can be perceived; the water itself appearing composed of innumerable globular points, in which a motion may be perceived somewhat similar to that which is observed when the sun's rays shine on the water; the whole multitude of animals appearing in commotion like a hive of bees. This animal is very common in ditch-water, and in almost all infusions either of animal or vegetable substances.

Monas atomus or *albida;* white monas with a variable point. This appears like a white point, which through a high magnifier appears somewhat egg-shaped. The smaller end is generally marked with a black point, the situation of which is variable; sometimes it appears on the large end, and sometimes there are two black spots in the middle. This species was found in sea water, which had been kept through the whole winter, but was not very fetid. No other kind of animalcule was found in it.

II. *The Proteus.*

An invisible, very simple, pellucid worm, of a variable form.

The *tenax*, running out into a fine point. This is a pellucid gelatinous body, stored with black molecules, and likewise changing its figure, but in a more regular order than the former. It first extends itself in a straight line, the lower part terminating in a bright acute point. It appears to have no intestines; and when the globules are all collected in the upper part, it next draws the pointed end up toward the middle of the body, which assumes a round form. It goes through a number of different shapes, part of which are described under the article ANIMALCULE. It is found in some kinds of river water, and appears confined almost entirely to one place, only bending sidewise.

III. *Volvox.*

An invisible, very simple, pellucid, spherical worm.

The *punctum;* of a black colour, with a lucid point. This is a small globule, with one hemisphere opaque and black, the other having a crystalline appearance; and a vehement motion is observed in the black part. It moves as on an axis, frequently passing through the drop in this manner. Many are often seen joined together in their passage through the water; sometimes moving as in a little whirlpool, and then separating. They are found in great numbers on the surface of fetid sea water.

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The *globulus*, with the hinder part somewhat obscure, sometimes verges a little towards the oval in its shape, having a slow fluttering kind of motion, but more quick when disturbed. The intestines are but just visible. It is found in most vegetable infusions, and is ten times large than the monas lens.

The *lunula*, with lunular molecules, is a small roundish transparent body, consisting of an innumerable multitude of homogeneous molecules of the shape of a crescent, without any common margin. It moves continually in a twofold manner, viz. of the molecules among one another, and the whole mass turning slowly round. It is found in marshy places in the beginning of spring.

IV. *Enchelis.*

A simple, invisible, cylindric worm.

The *viridis*, or green enchelis, has an obtuse tail, the fore part terminating in an acute truncated angle; the intestines are obscure and indistinct. It continually varies its motion, turning from right to left.

The *punctifera*, having the fore part obtuse, the hinder part pointed. It is opaque, and of a green colour, with a small pellucid spot in the fore part, in which two black points may be seen; and a kind of double band crosses the middle of the body. The hinder part is pellucid and pointed, with an incision supposed to be the mouth, at the apex of the fore part. It is found in marshes.

The *pupula*, with the fore part papillary, is found in dunghill water in November and December: it has a rotatory motion on a longitudinal axis, and moves in an oblique direction through the water. Both ends are obtuse; and the hinder part is marked with a transparent circle, or circular aperture.

V. *Vibrio.*

A very simple, invisible, round, and rather long worm.

The *lineola* is found in most vegetable infusions in such numbers, that it seems to fill up almost the whole of their substance. It is so small, that with the best magnifiers we can discern little more than an obscure tremulous motion among them. It is more slender than the monas terma.

The *serpens*, with obtuse windings or flexures, is found in river water, but seldom. It is slender and gelatinous, resembling a serpentine line, with an intestine down the middle.

The *spirillum* is exceedingly minute, and twisted in a spiral form, which seems to be its natural shape, as it never untwists itself, but moves forward in a straight line, vibrating the hind and fore parts. It was found in 1782 in an infusion of the sonchus arvensis.

The *vermiculus* has a milky appearance, with an obtuse apex, and a languid undulatory motion, like that of the common worm. It is found in marshy water in

Microscope. November, but seldom. It is thought to be the animal mentioned by Leeuwenhoeck as found in the dung of the frog and spawn of the male libellula.

The *sagitta*, with a setaceous tail, has a long and flexible body; broadest about the middle, and filled there also with gray molecules; the fore part being drawn out into a thin and transparent neck, and the upper end thick and black. It is found in salt water, and seems to move by contracting and extending its neck.

VI. *Cyclidium.*

A simple, invisible, flat, pellucid, orbicular or oval worm.

The *bulla*, or orbicular bright cyclidium. This is found occasionally in an infusion of hay. It is very pellucid and white, but the edges somewhat darker than the rest. It moves slowly, and in a semicircular direction.

The *millium* is very pellucid, and splendid like crystal; and of an elliptical figure, with a line through the whole length of it. The motion is swift, interrupted, and fluttering.

VII. *Paramœcium.*

An invisible, membranaceous, flat, and pellucid worm.

The *chrysalis* is found in salt water, and differs very little from the former, only the ends are more obtuse, and the margins are filled with black globules.

The *versutum* is found in ditches, and has an oblong, green, and gelatinous body, filled with molecules; the lower part thicker than the other; and both ends obtuse. It propagates by division.

VIII. *Kolpoda.*

An invisible, pellucid, flat, and crooked worm.

The *lamella* is very seldom met with. It resembles a long, narrow, and pellucid membrane, with the hind part obtuse, narrower, and curved towards the top. It has a vacillatory and very singular motion; going upon the sharp edge, not on the flat side as is usual with microscopic animals.

The *gallinula* is found in fetid salt water; and has the apex somewhat bent, the belly oval, convex, and striated.

The *rostrum* is found, though seldom, in water where the lemna grows; and has a slow and horizontal motion. The fore part is bent into a kind of hook; the hind part obtuse, and quite filled with black molecules.

The *triquetra* was found in salt water, and appears to consist of two membranes; the upper side flattened, the lower convex, with the apex bent into a kind of shoulder.

The *assimilis* is found on the sea-coast, and has an elliptic mass in the middle, but is not folded like the former. The margin of the fore part is notched from the top to the middle; the lower part swells out, and contracts again into a small point.

The *cucullulus* is found in an infusion of the sonchus arvensis. It is very pellucid and crystalline, with several globules, and has an oblique incision a little below the apex. Microscope.

The *ren*, or *crassa*, is found in an infusion of hay, commonly about 13 hours after the infusion is made, and has a quick and vacillatory motion. Its body is yellow, thick, and somewhat opaque; curved a little in the middle, so that it resembles a kidney; and full of molecules. When the water in which it swims is about to fail, it takes an oval form, is compressed, and at last bursts.

IX. *Gonium.*

An invisible, simple, smooth, and angular worm.

The *pulvinatum* is found in dunghills; and appears like a little quadrangular membrane, plain on both sides; but with a large magnifier it appears like a bolster formed of three or four cylindric pillows sunk here and there.

The *corrugatum* is found in various kinds of infusions; and is somewhat of a square shape, very small, and in some positions appears as streaked.

The *truncatum* is found chiefly in pure water, and then but seldom. It has a languid motion, and is much larger than the foregoing. The fore part is a straight line, with which the sides form obtuse angles, the end of the sides being united by a curved line. The internal molecules are of a dark green, and there are two little bright vesicles in the middle.

X. *Bursaria.*

A very simple, hollow, membranaceous worm.

The *truncatella* is visible to the naked eye; white, oval, and truncated at the top, where there is a large aperture descending towards the base. Most of them have four or five yellow eggs, at the bottom. They move from left to right, and from right to left; ascending to the surface in a straight line, and sometimes rolling about while they descend.

The *bullina* is pellucid and crystalline, having splendid globules of different sizes swimming about with it. The under side is convex, the upper hollow, with the fore part forming a kind of lip.

The *hirundinella* has two small projecting wings, which give it somewhat of the appearance of a bird: and it moves something like a swallow. It is invisible to the naked eye; but by the microscope appears a pellucid hollow membrane.

The *duplella* was found among duckweed, and appears like a crystalline membrane folded up, without any visible intestines except a small congeries of points under one of the folds.

XI. *Cercaria.*

An invisible transparent worm with a tail.

The *gyrinus* greatly resembles the spermatic animalcules. It has a white gelatinous body; the fore part somewhat globular; the hind part round, long, and pointed. Sometimes it appears a little compressed on each side. When swimming it keeps its tail in continual vibration like a tadpole.

The *gibba* is found in the infusions of hay and other vegetables;

Microscope.

vegetables; and is small, opaque, gelatinous, white, and without any visible intestines.

The *inquieta* is found in salt water, and is remarkable for changing the shape of its body: sometimes it appears spherical, sometimes like a long cylinder, and sometimes oval. It is white and gelatinous, the tail filiform and flexible, the upper part vibrating violently. A pellucid globule may be observed at the base, and two very small black points near the top.

The *turbo*, with a tail like a bristle, is found among duckweed. It is of a taley appearance, partly oval and partly spherical; and seems to be composed of two globular bodies, the lowermost of which is the smallest, and it has two little black points like eyes on the upper part. The tail is sometimes straight, sometimes turned back on the body.

The *poduria* is found in November and December, in marshy places covered with lemna. It is pellucid; and seems to consist of a head, trunk, and tail: the head resembles that of a herring; the trunk is ventricose and full of intestines, of a spiral form and black colour. The tail most commonly appears to be divided into two bristles. The intestines are in a continual motion when the body moves, and by reason of their various shades make it appear very rough. There are likewise some hairs to be perceived. It turns round as upon an axis when it moves.

The *viridis* is found in the spring in ditches of standing water; and in some of its states has a considerable resemblance to the last, but has a much greater power of changing its shape. It is naturally cylindrical, the lower end sharp, and divided into two parts; but sometimes contracts the head and tail so as to assume a spherical figure.

The *setifera* is found in salt water, but seldom. It is small, the body rather opaque, and of a round figure. The upper part is bright, and smaller than the rest: the trunk is more opaque; the tail sharp, and near it a little row of short hairs. It has a slow rotatory motion.

The *hirta* was likewise found in salt water. It is opaque and cylindrical; and when in motion, the body appears to be surrounded with rows of small hairs separated from each other.

The *pleuronectes* is found in water which has been kept for several months. It is membranaceous, roundish, and white, with two blackish points in the fore part, the hinder part being furnished with a slender sharp tail. It has orbicular intestines of different sizes in the middle; the larger of them bright. The motion is vacillatory; and in swimming it keeps one edge of the lateral membrane upwards, the other folded down.

The *tripos* is flat, pellucid, triangular, having each angle of the base or fore part bent down into two linear arms, the apex of the triangle prolonged into a tail. It is found in salt water.

XII. *Leucophra.*

An invisible, pellucid, and ciliated worm.

The *mamilla* is of a dark colour, and filled with globular molecules; short hairs are curved inwards; and it occasionally projects and draws in a little white protuberance. It is pretty common in marshy water.

The *virescens* is a large, pear-shaped, greenish-coloured animalcule, filled with opaque molecules, and covered with short hairs; generally moving in a straight line. It is found in salt water.

Microscope.

The *bursata* is found in salt water, and is similar in many respects to the former. It is of a long oval shape, bulging in the middle, and filled with green molecules, everywhere ciliated except at the apex, which is truncated and shaped somewhat like a purse; the hairs are sometimes collected into little fascicles.

The *posthuma* is globular, and covered as it were with a pellucid net; is found in fetid salt water.

The *signata* is common in salt water in the months of November and December. It is oblong and subdepressed, with a black margin filled with little molecules, but more particularly distinguished by a curved line in the middle somewhat in the shape of the letter S; one end of which is sometimes bent into the form of a small spiral.

XIII. *Trichoda.*

An invisible, pellucid, hairy worm.

The *gyrinus* is one of the smallest of this genus, and is found in salt water. It is smooth and free from hairs, except at the fore part, where there are a few.

The *nigra* was found in salt water, and has an opaque body; but when at rest one side appears pellucid. When in violent motion, it seems entirely black.

The *pubes* is found in water where duckweed grows, chiefly in the month of December. It has a bunch above the hind part marked with black spots, depressed towards the top, a little folded, and somewhat convex on the under part. The apex is furnished with hairs, but they are seldom visible till the creature is in the agonies of death, when it extends and moves them vehemently, and attempting as it were to draw in the very last drop of water.

The *patens* is found in salt water; and is of a long cylindrical shape, filled with molecules, the fore part bright and clear, with a long opening near the top which tapers to a point, and is beset with hairs.

The *striata* is found in the month of December in river water. It is a beautiful animalcule, of a fox colour. It is of an oblong shape, the lower end somewhat larger than the other. It has a set of streaks running from one end to the other, and at the abdomen a double row of little eggs lying in a transverse direction.

The *uvula* is found in the infusion of hay and other vegetables. It is six times longer than broad, round, flexuous, of an equal size, the greater part filled with obscure molecules; the fore part rather empty, with an alimentary canal and lucid globules near the middle. The margin of the fore part is covered with short hairs.

The *linter* is found in an infusion of old grass. It is egg-shaped, oblong, with both extremities raised so that the bottom becomes convex, and the upper part depressed like a boat: it is of different shapes at different ages, and sometimes has a rotatory motion.

The *pusillus* is found in salt water; and is long, full of gray molecules; the fore part truncated and hairy, and rather smaller than the other.

The *vermicularis* is found in river water; and is pel-

Micro-scope.

lucid in the fore part, with the hind part full of molecules.

The *melitæa* is found in salt water, but very rarely. It is oblong, ciliated, with a globular apex, a dilatable neck, and a kind of peristaltic motion perceivable within it.

The *perillum* is frequently found in marshes. It is cylindrical, pellucid, muscular, and capable of being folded up. It appears double; the interior part full of molecules, with an orbicular muscular appendage, which it can open and shut, and which forms the mouth. The external part is membranaceous, pellucid, dilated, and marked with transverse streaks; and it can protrude or draw in the orbicular membrane at pleasure. Some have four articulations in the tail, others five; and it has two pairs of bristles, one placed at the second joint, the other at the last.

The *delphis* is found in river water. It is smooth, pellucid, having the fore part dilated into a semicircle, gradually decreasing in breadth towards the tail. The front is hairy, the hairs standing as rays from the semicircular edge: one of the edges is sometimes contracted.

The *delphinus* is found in hay that has been infused for some months. It is pellucid, smooth, and egg-shaped; the hinder part terminating in a tail about half the length of the body, dilated at the upper end, truncated, and always bent upwards. It moves sometimes on its belly and sometimes on its side.

The *rostrata* is found in water where duckweed has been kept. It is depressed, capable of changing its shape, yellow, with long ciliated hairs; it has four feet tapering to a point, one of them longer than the rest. Both feet and hairs are within the margin. The shape of the body is generally triangular; the apex formed into an obtuse beak, which the creature sometimes draws in so that it appears quite round.

The *charon* was found in salt water. It is oval, and resembles a boat as well in its motion as shape; the upper part is hollowed, the under part furrowed and convex; the stern round, with several hairs proceeding from it.

XIV. *Kerona.*

An invisible worm with horns.

The *rastellum* is found in river water. It has three rows of horns on the back, which occupy almost the whole of it.

The *cypris* is found in water covered with lemna. It is somewhat of a pear shape, compressed, with a broad and blunt fore part; the front furnished with hairs, or little vibrating points inserted under the edge, shorter in the hind part, partly extended straight, and partly bent down, having a retrograde motion.

The *calvitium* is found in the infusion of vegetables. The body is broad and flat, both sides obtuse, filled with black molecules, and there is a black spot near the hinder part, where there are likewise a few short bristles.

The *pustulata* is found in salt water. It is oval, convex; one edge of the hinder part sinuated, both ends set with hairs, and some horns on the fore part.

XV. *Himantopus.*

Micro-scope.

A pellucid, invisible, and cirrated worm.

The *acarus* is lively, conical, ventricose, full of black molecules, with a bright and transparent fore part. The lower part of the apex has rows of long hairs on the under part set like rays. Four locks of long crooked hair or feet proceed from the belly, and it is continually moving these and other hairs in various directions.

The *ludio* is a lively diverting animalcule, smooth, pellucid, full of small points, the fore part clubbed and a little bent, the hinder part narrow; the base obliquely truncated, and terminating in a tail stretched out transversely. The top of the head and middle of the back are furnished with long and vibrating hairs; three moveable and flexible curls hang down from the side of the head at a distance from each other. When the creature is at rest, its tail is curled; but when in motion, it is drawn tight and extended upwards.

The *sannio* is found, though seldom, in water where the lemna grows. The cilia are longer than the hairs, and are continually vibrating: it has two moveable curls hanging on the side of the head.

The *charon* is found in sea water, but rarely. It is oval, pellucid, and membranous, with longitudinal furrows and several bent diverging rows of hair below the middle, but none on the hinder part.

XVI. *Verticella.*

A naked worm with rotatory cilia, capable of contracting and extending itself.

The *lunifera*, is found in salt water; has the fore part obtuse, the base broad, and hollowed away like a crescent, with a short protuberance in the middle of the concave part: the fore part is ciliated.

The *bursata* is found in salt water, and is ventricose, crammed with molecules; the fore part truncated, and both sides of it pellucid: there is a prominent papilla in the middle, which when the animalcule is at rest appears notched, the edge of the aperture being ciliated; the hairs are capable of moving in various directions.

The *sputarium* is found in October, with the lesser lemna, and is one of the most singular of the microscopic animalcules. When viewed sidewise, it is sometimes nearly cylindrical, only tapering a little towards the hinder part, and having a broad pellucid edge. Viewed from the top, it has sometimes a broad face or disk, furnished with radiating hairs, the under part contracted into a globular shape, of a dark green colour, and filled with small grains.

The *multiformis* is found in salt water, and very much resembles the former.

The *nigra* is found in August in meadows covered with water. It may be seen with the naked eye, appearing like a black point swimming on the surface. Through the microscope it appears as a small conical body, obtuse and ventricose at one end, and acute at the other. When the extremities are extended, two small white hooks become visible, by the assistance of which

Microscope.

which it moves in the water, and it probably has a rotatory organ: it moves continually in a vacillating manner on the top of the water.

The *ocreata* is met with in rivers, though very seldom, and in shape somewhat resembles the lower part of a boot. The apex of the upper part is truncated and ciliated, the heel pointed, and the foot round.

The *valga* is as broad as long, and the apex truncated and ciliated; both angles of the base projecting outwards, one somewhat like a wart, the other like a finger. It is found in marshy waters.

The *papillaris* is likewise found in marshes where the conserva nitida grows. It is ventricose; the fore part truncated, with a papillary tail, and a beautiful papillary excrescence on the side.

The *cratægaria* is found in the month of April, both in the mud and on the tail of the monoculus quadricornis. They are generally heaped together in a spherical form, and united to one common stalk. They are likewise often to be found without a pedicle, the body rather contracted, the aperture circular, and surrounded with a marked margin. It has two small arms; and with a powerful magnifier a violent rotatory motion may be observed. Sometimes an individual will separate from the community, and move in a kind of spiral line for a little time, and then go back to the rest.

The *rotatoria* is the *wheel animal* described by Mr Baker; and of which an account is given under the article ANIMALCULE.

The *furcata* is commonly found in water, and has a cylindric body with a rotatory organ, consisting of a row of hairs at the apex: the tail is divided into two parts, turning a little inwards. When at rest it joins the segments of the tail, but opens them when in motion.

The *citrina* is found in stagnant water; the head full of molecules, round, everywhere of an equal size, and very transparent. Both sides of the orifice are ciliated, and each has a rotatory motion, appearing sometimes without and sometimes within the edge of the mouth.

The *convallaria* is the same with the *bell-animal* mentioned by Mr Baker. See the article ANIMALCULE.

The *acinosa* inhabits that whitish substance which often entirely covers plants, wood, shells, &c. When this substance is examined by a microscope, it appears to be wholly composed of living animals of the polype kind. See POLYPE.

The *pyraria*.
The *anastatica*
The *digitalis*.
} See the article POLYPE.

XVII. *Brachionus*.

A contractile worm, covered with a shell, and furnished with rotatory cilia.

The *patella* is found in marshy water in the wintertime. It is univalve, the shell oval, plain, crystalline, with the anterior part terminating in two acute points on both sides, though the intervening space is commonly filled up with the head of the animal. By these points it fastens itself, and whirls about the body erect. The rotatory cilia are perceived with great difficulty.

To what has been already said on this subject, under the article ANIMALCULE, we shall here add the following observations from Mr Adams.—"How many kinds of these invisibles there may be (says he), is yet unknown; as they are discerned of all sizes, from those which are barely invisible to the naked eye, to such as resist the force of the microscope as the fixed stars do that of the telescope, and with the greatest powers hitherto invented appear only as so many moving points. The smallest living creatures our instruments can show, are those which inhabit the waters; for though animalcula equally minute may fly in the air, or creep upon the earth, it is scarcely possible to get a view of them; but as water is transparent, by confining the creatures within it we can easily observe them by applying a drop of it to the glasses.

"Animalcules in general are observed to move in all directions with equal ease and rapidity, sometimes obliquely, sometimes straight forward; sometimes moving in a circular direction, or rolling upon one another, running backwards and forwards through the whole extent of the drop, as if diverting themselves; at other times greedily attacking the little parcels of matter they meet with. Notwithstanding their extreme minuteness, they know how to avoid obstacles, or to prevent any interference with one another in their motions: sometimes they will suddenly change the direction in which they move, and take an opposite one; and, by inclining the glass on which the drop of water is, as it can be made to move in any direction, so the animalcules appear to move as easily against the stream as with it. When the water begins to evaporate, they flock towards the place where the fluid is, and show a great anxiety and uncommon agitation of the organs with which they draw in the water. These motions grow languid as the water fails, and at last cease altogether, without a possibility of renewal if they be left dry for a short time. They sustain a great degree of cold as well as insects, and will perish in much the same degree of heat that destroys insects. Some animalcules are produced in water at the freezing point, and some insects live in snow. —By mixing the least drop of urine with the water in which they swim, they instantly fall into convulsions and die.

"The same rule seems to hold good in those minute creatures, which is observable in the larger animals, viz. that the larger kinds are less numerous than such as are smaller, while the smallest of all are found in such multitudes, that there seem to be myriads for one of the others. They increase in size, like other animals, from their birth until they have attained their full growth; and when deprived of proper nourishment, they in like manner grow thin and perish."

The modes of propagation among these animalcules are various, and the observation of them is extremely curious. Some multiply by a transverse division, as is observed under the article ANIMALCULE: and it is remarkable, that though in general they avoid one another, it is not uncommon, when one is nearly divided, to see another push itself upon the small neck which joins the two bodies in order to accelerate the separation.—Others, when about to multiply, fix themselves to the bottom of the water; then becoming first oblong, and afterwards round, turn rapidly as on a centre, but perpetually varying the direction of their rotatory motion

Micro-scope. motion. In a little time, two lines forming a cross are perceived; after which the spherule divides into four, which grow, and are again divided as before. A third kind multiply by a longitudinal division, which in some begins in the fore part, in others in the hind part; and from others a small fragment detaches itself, which in a short time assumes the shape of the parent animalcule. Lastly, others propagate in the same manner as the more perfect animals.

In our observations under the article ANIMALCULE, we suggested some doubts whether all those minute bodies which go under the name of *animalcules* really do enjoy animal life; or whether they are not in many cases to be accounted only inanimate and exceedingly minute points of matter actuated by the internal motion of the fluid. This has also been the opinion of others: but to all hypotheses of this kind Mr Adams makes the following reply: "From what has been said, it clearly appears, that their motions are not purely mechanical, but are produced by an internal spontaneous principle; and that they must therefore be placed among the class of living animals, for they possess the strongest marks and the most decided characters of animation; and, consequently, that there is no foundation for the supposition of a chaotic and neutral kingdom, which can only have derived its origin from a very transient and superficial view of those animalcules.—It may also be further observed, that as we see that the motions of the limbs, &c. of the larger animals, are produced by the mechanical construction of the body, and the action of the soul thereon, and are forced by the ocular demonstration which arises from anatomical dissection to acknowledge this mechanism which is adapted to produce the various motions necessary to the animal; and as, when we have recourse to the microscope, we find those pieces which had appeared to the naked eye as the primary mechanical causes of particular motions, to consist themselves of lesser parts, which are the causes of motion, extension, &c. in the larger; when the structure therefore can be traced no farther by the eye, or by the glasses, we have no right to conclude that the parts which are invisible are not equally the subject of mechanism: for this would be only to assert in other words, that a thing may exist because we see and feel it, and have no existence when it is not the object of our senses.—The same train of reasoning may be applied to microscopic insects and animalcula: we see them move; but because the muscles and members which occasion these motions are invisible, shall we infer that they have not muscles, with organs appropriated to the motion of the whole and its parts? To say that they exist not because we cannot perceive them, would not be a rational conclusion. Our senses are indeed given us that we may comprehend some effects; but then we have also a mind, with reason, bestowed upon us, that, from the things which we do perceive with our senses, we may deduce the nature of those causes and effects which are imperceptible to the corporeal eye."

Leaving these speculations, however, we shall now proceed to give a particular

Explanation of the figures of the various animals, with their parts, ova, &c. represented in the plates.

Plate CCXLII. Fig. 32. 33. represent the eggs of the phalæna neustria, as they are taken from the tree to which they adhere, and magnified by the microscope. The strong ground-work visible in many places shews the gum by which they are fastened together; and this connexion is strengthened by a very tenacious substance interposed between the eggs, and filling up the vacant spaces. Fig. 34. shows a vertical section of the eggs, exhibiting their oval shape.—Fig. 35. is an horizontal section through the middle of the egg. These eggs make a beautiful appearance through the microscope. The small figures *a*, *b*, *c*, represent the objects in their natural state, without being magnified. Micro-scope. Fig. 34. Fig. 35.

Fig. 36. shows the larva of the *musca chamæleon*, an aquatic insect. When viewed by the naked eye, it appears (as here represented) to be composed of twelve annular divisions, separating it into an head, thorax, and abdomen: but it is not easy to distinguish the two last parts from each other, as the intestines lie equally both in the thorax and abdomen. The tail is furnished with a fine crown or circle of hair *b*, disposed in the form of a ring, and by this means it is supported on the surface of the water, the head and body hanging down towards the bottom, in which posture it will sometimes remain for a considerable time without any motion.—When it has a mind to sink to the bottom, it closes the hairs of the ring, as in fig. 37. Thus an hollow space is formed, including a small bubble of air; by enlarging or diminishing which, it can rise or sink in the water at pleasure. When the bubble escapes, the insect can replace it from the pulmonary tubes, and sometimes considerable quantities of air may be seen to escape from the tail of the worm into the common atmosphere; which operation may easily be observed when the worm is placed in a glass of water, and affords an interesting spectacle. The snout of this insect is divided into three parts, of which that in the middle is immoveable; the other two, which grow from the sides of the middle one, are moveable, and vibrate like the tongues of lizards or serpents. In these lateral parts lies most of the creature's strength; for it walks upon them when out of the water, appearing to walk on its mouth, and to use it as the parrot does its beak to assist it in climbing. Fig. 36. Fig. 37.

The larva is shown, fig. 38. as it appears through a microscope. It grows narrower towards the head, is largest about that part which we may call the thorax, converges all along the abdomen, and terminates at length in a sharp tail surrounded with hairs, as has already been mentioned. The twelve annular divisions are now extremely visible, and are marked by numbers in the plate. The skin appears somewhat hard, and resembling shagreen, being thick set with grains pretty equally distributed. It has nine holes, or spiracula, probably for the purpose of breathing, on each side; but it has none of these on the tail division *a*, nor any easily visible on the third from the head. In the latter, indeed, it has some very small holes concealed under the skin, near the place where the embryo wings of the future fly are hid. "It is remarkable says Mr Adams) that caterpillars, in general, have two rings without these spiracula, perhaps because they change into flies with four wings, whereas this worm produces a fly with only two." The skin of the larva is adorned with oblong black furrows, spots of a light colour, and orbicular rings, from which there generally springs Fig. 38.

Microscope.

a hair; but only those hairs which grow on the insect's sides are represented in the figure. There are also some larger hairs here and there, as at *c c*. The difference of colour, however, in this worm arises only from the quantity of grains in the same space; for where they are in very great numbers, the furrows are darker, and paler where they are less plentiful.

The head *d* is divided into three parts, and covered with a skin which has hardly any discernible grains.—The eyes are rather protuberant, and lie near the snout; on which last are two small horns at *i i*. It is crooked, and ends in a sharp point as at *f*. The legs are placed near the snout between the sinuses in which the eyes are fixed. Each of these legs consists of three joints, the outermost of which is covered with stiff hairs like bristles *g g*. From the next joint there springs a horny bone *h h*, used by the insect as a kind of thumb; the joint is also composed of a black substance of an intermediate hardness between bone and horn; and the third joint is of the same nature. In order to distinguish these parts, those that form the upper sides of the mouth and eyes must be separated by means of a small knife; after which, by the assistance of the microscope, we may perceive that the leg is articulated by some particular ligaments, with the portion of the insect's mouth which answers to the lower jaw in the human frame. We may then also discern the muscles which serve to move the legs, and draw them up into a cavity that lies between the snout and those parts of the mouth which are near the horns *i i*. The insect walks upon these legs, not only in the water, but on the land also. It likewise makes use of them in swimming, keeping its tail on the surface contiguous to the air, and hanging downward with the rest of the body in the water. In this situation, the only perceptible motion it has is in its legs, which it moves in a most elegant manner, from whence it is reasonable to conclude, that the most of this creature's strength lies in its legs, as we have already observed.

The snout of this larva is black and hard: the back part quite solid, and somewhat of a globular form; the front *f* sharp and hollow. Three membranaceous divisions may be perceived on the back part; by means of which, and the muscles contained in the snout, the creature can contract or expand it at pleasure.

The extremity of the tail is surrounded with thirty hairs, and the sides adorned with others that are smaller; and here and there the large hairs branch out into smaller ones, which may be reckoned single hairs. All these have their roots in the outer skin, which in this place is covered with rough grains, as may be observed by cutting it off and holding it against the light upon a slip of glass. Thus also we find, that at the extremities of the hairs there are grains like those on the skin; and in the middle of the tail there is a small opening, within which are minute holes, by which the insect takes in and lets out the air it breathes. These hairs, however, are seldom disposed in such a regular order as is represented in fig. 38. unless when the insect floats with the body in the water, and the tail with its hairs a little lower than the surface, in which case they are disposed exactly in the order delineated in the plate. The least motion of the tail downwards produces a concavity in the water; and it then assumes the figure of a wine glass, wide at the top and narrow at the bottom. The tail answers the double purpose of swimming and breathing, and through it the insect receives what is the principle of life and motion to all animals. By means of these hairs also it can stop its motion when swimming, and remain suspended quietly without motion for any length of time. Its motions in swimming are very beautiful, especially when it advances with its whole body floating on the surface of the water, after filling itself with air by the tail.—To set out, it first bends the body to the right or left, and then contracts it in the form of the letter S, and again stretches it out in a straight line: by thus contracting and then extending the body alternately, it moves on the surface of the water. It is very quiet, and is not disturbed by handling.

Microscope.

These creatures are commonly found in shallow standing waters in the beginning of June: but some years much more plentifully than others. They crawl on the grass and other plants which grow in such waters, and are often met with in ditches, floating on the surface of the water by means of their tail, the head and thorax at the same time hanging down; and in this posture they turn over the clay and dirt with their snout and feet in search of food, which is commonly a viscous matter met with in small ponds and ditches. It is very harmless, though its appearance would seem to indicate the contrary. It is most easily killed for dissection by spirit of turpentine.

Fig. 39. shows in its natural size a beautiful insect, described by Linnæus under the name of *Leucopsis dorsigera*, and which appears to be a kind of intermediate genus between a sphex and a wasp. The antennæ are black and cylindrical, increasing in thickness towards the extremity; the joint nearest the head is yellow; the head and thorax are black, encompassed with a yellow line, and furnished with a cross line of the same colour near the head. The scutellum is yellow, the abdomen black, with two yellow bands, and a deep spot of the same colour on each side between the bands. A deep polished groove extends down the back from the thorax to the anus, into which the sting turns and is deposited, leaving the anus very circular; a yellow line runs on each side of the sting.—The anus and whole body, when viewed with a small magnifier, appear punctuated; but when these points are seen through a large magnifier, they appear hexagonal. Fig. 40. shows the insect very much magnified. Fig. 41. gives a side view of it magnified in a smaller degree.

Fig. 39.

Fig. 40. 41.

Plate CCCXLIII. fig. 42.

Fig. 42. shows an insect discovered by Mr John Adams of Edmonton, as he happened to be at an inn. It was first seen by some labouring people who were there at the time, by whom it was conjectured to be a louse with unusually long horns, a mite, &c. Mr Adams hearing the debate, procured the insect; and having viewed it through a microscope, it presented the appearance exhibited in fig. 42. The insect seems to be quite distinct from the phalangium cancroides of Linnæus. The latter has been described by several authors, but none of their descriptions agree with this. The abdomen of this insect is more extended, the claws larger, and much more obtuse; the body of the other being nearly orbicular, the claws slender, and almost terminating in a point, more transparent, and of a paler colour. Mr Marsham has

Micro-scope. in his possession not to be distinguished from that represented in fig. 42. excepting only that it wants the break or dent in the claws, which is so conspicuous in this. He found that insect firmly fixed by its claws to the thigh of a large fly, which he caught on a flower in Essex in the first week of August, and from which he could not disengage it without great difficulty, and tearing off the leg of the fly. This was done upon a piece of writing paper; and he was surprised to see the little creature spring forward a quarter of an inch, and again seize the thigh with its claws, so that he had great difficulty in disengaging it. The natural size of this creature, which Mr Adams calls the *lobster-insect*, is exhibited at *a*.

Fig. 43. Fig. 43. shows the insect named by M. de Geer *Physapus*, on account of the bladders at its feet, (*Thrips physapus*, Lin.). This insect is to be found in great plenty upon the flowers of dandelion, &c. in the spring and summer. It has four wings, two upper and two under ones (represented fig. 44.); but the two undermost are not to be perceived without great difficulty. They are very long; and fixed to the upper part of the breast, lying horizontally. Both of them are rather pointed towards the edges, and have a strong nerve running round them, which is set with a hair fringe tufted at the extremity. The colour of these wings is whitish: the body of the insect is black; the head small, with two large reticular eyes. The antennæ are of an equal size throughout, and divided into six oval pieces, which are articulated together.—The extremities of the feet are furnished with a membranaceous and flexible bladder, which it can throw out or draw in at pleasure. It presses this bladder against the substances on which it walks, and thus seems to fix itself to them; the bladder sometimes appears concave towards the bottom, the concavity diminishing as it is less pressed. The insect is represented of its natural size at *b*.

Fig. 44.

Fig 45. Fig. 45. represents the *cimex striatus* of Linnæus, remarkable for very bright and elegantly disposed colours, though few in number. The head, proboscis, and thorax, are black: the thorax ornamented with yellow spots; the middle one large, and occupying almost one-third of the posterior part; the other two are on each side, and triangular. The scutellum has two yellow oblong spots, pointed at each end. The ground of the elytra is a bright yellow; spotted and striped with black. The nerves are yellow; and there is a brilliant triangular spot of orange, which unites the crustaceous and membranaceous parts; the latter are brown, and clouded. It is found in the elm tree in June. It is represented of its natural size at *c*.

Fig. 46. Fig. 46. shows the *chrysomela asparagi* of Linnæus, so called from the larva of the insect feeding upon that plant. It is a common insect, and very beautiful. It is of an oblong figure, with black antennæ, composed of many joints, nearly oval. The head is a deep and bright blue; the thorax red and cylindrical: the elytra are blue, with a yellow margin, and having three spots of the same colour on each; one at the base, of an oblong form, and two united with the margin: the legs are black; but the under side of the belly is of the same blue colour with the elytra and head. This little animal, when viewed by the naked eye, scarcely appears to deserve any notice; but when examined by the microscope, is one of the most pleasing opaque objects we have. It is found in June on the asparagus after it has run to seed; and it is shown of its natural size at *d*. De Geer says that it is very scarce in Sweden.

Micro-scope.

Fig. 47. Fig. 47. shows an insect of a shape so remarkable, that naturalists have been at a loss to determine the genus to which it belongs. In the Fauna Suecica, Linnæus makes it an *attelabus:* but in the last edition of the Systema Naturæ, it is ranged as a meloe, under the title of the *Meloe monoceros;* though of this also there seems to be some doubt. The true figure of it can only be discovered by a very good microscope. The head is black, and appears to be hid or buried under the thorax, which projects forward like a horn: the antennæ are composed of many joints, and are of a dirty yellow colour, as well as the feet: the hinder part of the thorax is reddish, the fore part black.—The elytra are yellow, with a black longitudinal line down the suture; there is a band of the same colour near the apex, and also a black point near the base, the whole animal being curiously covered with hair. The natural size of it is shown at *e*. It was found in May. Geoffroy says that it lives upon umbelliferous plants.

Plate CCCXLIII. fig. 48—54. Fig. 48.—54. exhibit the anatomy of the cossus caterpillar, which lives on the willow. The egg from which it proceeds is attached to the trunk of the tree by a kind of viscous juice, which soon becomes so hard that the rain cannot dissolve it. The egg itself is very small and spheroidical, and, when examined by the microscope, appears to have broad waving furrows running through the whole length of it, which are again crossed by close streaks, giving it the appearance of a wicker basket. It is not exactly known what time they are hatched; but as the small caterpillars appear in September, it is probable that the eggs are hatched some time in August. When small, they are generally met with under the bark of the tree to which the eggs were affixed; and an aqueous moisture, oozing from the hole through which they got under the bark, is frequently, though not always, a direction for finding them. These caterpillars change their colour but very little, being nearly the same when young as when old. Like many others, they are capable of spinning as soon as they come from the egg. They also change their skin several times; but as it is almost impossible to rear them under a glass, so it is very difficult to know exactly how often this moulting takes place.—Mr Adams conjectures that it is more frequently than the generality of caterpillars do, some having been observed to change more than nine times.

The cossus generally fasts for some days previous to the moulting; during which time the fleshy and other interior parts of the head are detached from the old skull, and retire as it were within the neck. The new coverings soon grow on, but are at first very soft.—When the new skin and the other parts are formed, the old skin is to be opened, and all the members withdrawn from it; an operation naturally difficult, but which must be rendered more so from the soft and weak state of the creature at that time. It is always much larger after each change.

From Mr Lyonet's experiments, it appears, that the

cossus

Microscope.

cossus generally passes at least two winters, if not three, before it assumes the pupa state. At the approach of winter, it forms a little case, the inside of which is lined with silk, and the outside covered with wood ground like very fine saw-dust. During the whole season it neither moves nor eats.

This caterpillar, at its first appearance, is not above one-twelfth of an inch long; but at last attains the length of two, and sometimes of three inches. In the month of May it prepares for the pupa state; the first care being to find a hole in the tree sufficient to allow the moth to issue forth; and if this cannot be found, it makes one equal in size to the future pupa. It then begins to form of wood a case or cone; uniting the bits, which are very thin, together by silk, into the form of an ellipsoid, the outside being formed of small bits of wood joined together in all directions; taking care, however, that the pointed end of the case may always be opposite to the mouth of the hole: having finished the outside of the case, it lines the inside with a silken tapestry of a close texture in all its parts, except the pointed end, where the texture is looser, in order to facilitate its escape at the proper time. The caterpillar then places itself in such a posture, that the head may always lie towards the opening of the hole in the tree or pointed end of its case. Thus it remains at rest for some time: the colour of the skin first becomes pale, and afterwards brown; the interior parts of the head are detached from the skull; the legs withdraw themselves from the exterior case; the body shortens; the posterior part grows small, while the anterior part swells so much, that the skin at last bursts; and, by a variety of motions, is pushed down to the tail; and thus the pupa is exhibited, in which the parts of the future moth may be easily traced.—The covering of the pupa, though at first soft, humid, and white, soon dries and hardens, and becomes of a dark purple colour; the posterior part is moveable; but not the fore part, which contains the rudiments of the head, legs, and wings. The fore-part of the pupa is furnished with two horns, one above and the other under the eyes. It has also several rows of points on its back. It remains for some weeks in the case; after which the moth begins to agitate itself, and the points are then of essential service, by acting as a fulcrum, upon which it may rest in its endeavours to proceed forward, and not slip back by its efforts for that purpose.

The moth generally continues its endeavours to open the case for a quarter of an hour: after which, by redoubled efforts, it enlarges the hole, and presses forward until it arrives at the edge, where it makes a full stop, lest by advancing further it should fall to the ground. After having in this manner reposed itself for some time, it begins to disengage itself entirely; and having rested for some hours with its head upwards, it becomes fit for action. Mr Marsham says, that it generally pushes one-third of the case out of the hole before it halts.

The body of the caterpillar is divided into twelve rings, marked 1, 2, 3, &c. as represented in fig. 48, 49, 50, 51. each of which is distinguished from that which precedes, and that which follows, by a kind of neck or hollow; and, by forming boundaries to the rings, we make twelve other divisions, likewise expressed in the figures; but to the first of these the word *ring* is affixed, and to the second, *division*. To facilitate the description of this animal, M. Lyonet supposed a line to pass down through the middle of the back, which he called the superior line, because it marked the most elevated part of the back of the caterpillar; and another, passing from the head down the belly to the tail, he called the inferior line.

Microscope.

All caterpillars have a small organ, resembling an elliptic spot, on the right and left of each ring, excepting the second, third, and last; and by these we are furnished with a further subdivision of this caterpillar, viz. by lines passing through the spiraeula, the one on the right side, the other on the left of the caterpillar. These four lines, which divide the caterpillar longitudinally into four equal parts, mark each the place under the skin which is occupied by a considerable viscus. Under the superior line lies the heart, or rather thread of hearts; over the inferior line, the spinal marrow; and the two tracheal arteries follow the course of the lateral lines. At equal distances from the superior and two lateral lines, we may suppose four intermediate lines. The two between the superior and lateral lines are called the intermediate superior; the two others opposite to them, and between the lateral and inferior lines, are called the intermediate inferior.

Fig. 48, 49. show the muscles of the caterpillar, arranged with the most wonderful symmetry and order, especially when taken off by equal strata on both sides, which exhibits an astonishing and exact form and correspondence in them. The figures show the muscles of two different caterpillars opened at the belly, and supposed to be joined together at the superior lines. The muscles of the back are marked by capitals; the gastric muscles by Roman letters; the lateral ones by Greek characters. Those marked θ are called, by M. Lyonet, dividing muscles, on account of their situation. Fig. 48. and 49.

The caterpillar was prepared for dissection by being emptied, and the muscles, nerves, &c. freed from the fat in the manner formerly directed: after which the following observations were made.

The muscle A in the first ring is double; the anterior one being thick at top, and being apparently divided into different muscles on the upper side, but without any appearance of this kind on the under side. One insertion is at the skin of the neck towards the head; the other is a little above; and that of the second muscle A is a little below the first spiraculum, near which they are fixed to the skin.

The muscle marked α is long and slender, fixed by its anterior extremity under the gastric muscles *a* and *b* of the first ring, to the circumflex scale of the base of the lower lip. It communicates with the muscle *c* of the second ring, after having passed under some of the arteries, and introduced itself below the muscle θ.

The muscle β is so tender, that it is scarcely possible to open the belly of the caterpillar without breaking it. It is sometimes double, and sometimes triple.—Anteriorly it is fixed to the posterior edge of the side of the parietal scale, the lower fixture being at the middle of the ring near the inferior line.

There are three muscles marked ξ; the first affixed

Microscope.

at one extremity near the lower edge of the upper part of the parietal scale; the other end divides itself into three or four tails, fixed to the skin of the caterpillar under the muscle ∂. The anterior part of the second is fixed near the first; the anterior part of the third a little under the first and second, at the skin of the neck under the muscle A. These two last passing over the cavity of the first pair of limbs, are fixed by several tails to the edge opposite to this cavity. In this subject there are two muscles marked ∂, but sometimes there is only one anteriorly; they are fixed to the lower edge of the parietal scale, the other ends being inserted in the first fold of the skin of the neck on the belly-side. Fig. 50. best represents the muscles β and ∂; as in that figure they do not appear injured by any unnatural connection.

In the second and four following rings we discern two large dorsal muscles A and B. In the 7th, 9th and 10th rings are three, A, B, and C; in the 11th are four, A, B, C, and D; and in the anterior part of the 12th ring are five, A, B, C, D, and E. All these ranges of muscles, however, as well as the gastric muscles *a*, *b*, *c*, *d*, appear at first sight only as a single muscle, running nearly the whole length of the caterpillar; but when this is detached from the animal, it is found to consist of so many distinct muscles, each consisting only of the length of one of the rings, their extremities being fixed to the division of each ring, excepting the middle muscle *a*, which, at the 6th, 7th, 8th, and 9th rings, has its insertions rather beyond the division. Each row of muscles appears as one, because they are closely connected at top by some of the fibres which pass from one ring to the other.

The muscles A, which are 12 in number, gradually diminish in breadth to the lower part of the last ring: at the 8th and three following divisions they communicate with the muscles B, and at the 11th with D. In the lower part of the last ring, A is much broader than it was in the preceding ring; one extremity of it is contracted, and communicates with B; the lower insertion being at the membrane I, which is the exterior skin of the fecal bag. The muscles A and B, on the lower part of the last ring, cannot be seen until a large muscle is removed, which on one side is fixed to the subdivision of the ring, and on the other to the fecal bag.

The right muscles B, which are also 12 in number, begin at the second ring, and grow larger from thence to the seventh. They are usually narrower from thence to the 12th; the deficiency in width being supplied by the six muscles C, which accompany it from the 7th to the subdivision of the 12th ring. The muscles B and C communicate laterally with the 8th, 11th, and 12th divisions. C is wanting at the subdivision of the 12th; its place being here supplied by B, which becomes broader at this part.

The first of the three floating muscles V originates at the first ring, from whence it introduces itself under N, where it is fixed, and then subdivides, and hides itself under other parts. The second begins at the second division, being fixed to the anterior extremity B of the second ring; from thence directing itself towards the stomach; and, after communicating with the case of the *corpus crassum*, it divides, and spreads into eight muscles which run along the belly. The third begins at the third division, originating partly at the skin, and partly at the junction of the muscles B of the second and third ring. It directs itself obliquely towards the belly, meeting it near the third spiraculum; and branching from thence, it forms the oblique muscles of some of the viscera.

Microscope.

The thin long muscle θ, which is at the subdivision of the last ring, and covers the anterior insertion of the muscle (*a*) where the ring terminates, is single. It begins at one extremity of the muscle (*c*); at the fore part of the ring runs along the subdivision round the belly of the caterpillar, and finishes, on the other side, at the extremity of a similar muscle C.

Fig. 49. shows the dorsal muscles of the cossus. To view which in an advantageous manner, we must use the following mode of preparation.

1. All the dorsal muscles, 35 in number, must be taken out, as well as the seven lateral ones already described.

2. All the straight muscles of the belly must be taken away, as well as the muscular roots (*c*), and the ends of the gastric muscles (*c*), which are at the third and fourth divisions.

3. At the second division the muscle θ must be removed; only the extremities being left to show where it was inserted.

The parts being thus prepared, we begin at the third ring; where there are found four dorsal muscles C, D, E, and F. The first one C, is inserted at the third division, under the muscles θ and α, where it communicates by means of some fibres with the muscle *f* of the second ring; proceeding from thence obliquely towards the intermediate superior line, and is fixed at the fourth division. As soon as C is retrenched, the muscle D is seen; which grows wider from the anterior extremity: it lies in a contrary direction to the muscle C, and is inserted into the third and fourth divisions. The muscle E lies in the same direction as the middle C, but not so obliquely: the lower insertion is at the fourth division; the other at the third, immediately under C. The muscle F is nearly parallel to D which joins it; the first insertion is visible, but the other is hid under the muscles E and G at the fourth division.

In the eight following rings, there are only two dorsal muscles; and of these D is the only one that is completely seen. It is very large, and diminishes gradually in breadth from one ring to the other, till it comes to the last, sending off branches in some places.—E is one of the strait muscles of the back; and is inserted under the dividing muscles θ, at the divisions of its own ring.

On the anterior part of the 12th ring there are three dorsal muscles, D, E, and F. D is similar to that of the preceding ring, marked also D, only that it is no more than half the length; terminating at the subdivision of its own ring. E is of the same length, and differs from the muscle E of the preceding ring only in its direction. F is parallel to E, and shorter than it; its anterior end does not reach the twelfth division.

On the posterior part there is only one dorsal muscle, fastened by some short ones to the subdivision of the last ring, traversing the muscles α; and being fixed there as if designed to strengthen them, and

to

Micro-scope. to vary their direction.—α Is a single muscle, of which the anterior insertion is visible, the other end being fixed to the bottom of the foot of the last leg; its use is to move the foot. The anterior part of the muscle β branches into three or four heads, which cross the superior line obliquely, and are fixed to the skin a little above it. The other end is fastened to the membrane T.

Fig. 50. 51. Fig. 50. and 51. show the muscles of the caterpillar when it is opened at the back. The preparation for this view is to disengage the fat and other extraneous matter, as before directed.

The first ring has only two gastric muscles (*c*) and (*d*): the former is broad, and has three or four little tails: the first fixture is at the base of the lower lip, from whence it descends obliquely, and is fixed between the inferior and lateral line. The small muscle (*d*) is fastened on one side to the first spiraculum; on the other, a little lower, to the intermediate inferior and lateral line; and seems to be an antagonist to the muscle P, which opens the spiracula. The posterior fixture of δ is under the muscle C, near the skin of the neck; β is fixed a little on the other side of C, at the middle of the ring.

In the second ring there are three gastric muscles, *g*, *h*, and *i*: *g* and *h* are fixed at the folds which terminate the ring; but only the anterior part of *i* is fixed there. The muscle *h* is triple, and in one of the divisions separated into two parts; that marked *i* comes nearer the inferior line, and is fixed a little beyond the middle of the ring, where the corresponding muscle of the opposite side is forked to receive it.

In the third ring, the muscle *h*, which was triple in the foregoing ring, is only double here, that part which is nearest the inferior line being broadest: it has three tails, of which only two are visible in the figure. It is exactly similar to that of the preceding ring; and is crossed in the same manner by the muscle from the opposite side of the ring.

Throughout the eight following rings, the muscle *f* which runs through them all is very broad and strong. The anterior part of it is fixed at the intermediate inferior line, on the fold of the first division of the ring: the other part is fixed beyond the lower division; with this difference, that at the 10th and 11th rings it is fixed at the last fold of its ring; whereas, in the others it passes over that ring, and is inserted into the skin of the following one. In all these, the first extremity of the muscle *g* is fastened to the fold which separates the ring from the preceding one, and is parallel to *f*, and placed at the side of it. The first six muscles marked *g*, are forked; that of the fourth ring being more so than the rest, nor does it unite till near its anterior insertion. The longest tail lays hold of the following, and is inserted near the inferior line; the other inserts itself near the same line, at about the middle of its own ring; the two last do not branch out; but terminate at the divisions, without reaching the following ring. The muscle *h*, placed at the side of *f*, has nearly the same direction, and finishes at the folds of the ring.

The anterior part of the 12th ring has only one gastric muscle, marked *c*: it is placed on the intermediate inferior line; and is inserted at the folds of the upper division, and at the subdivision of this ring. The lower part has a larger muscle marked *c*, with several divisions; one placed under *b*, with one extremity fixed near the lateral line, at the subdivision of its ring; the other to the fecal bag, a little lower than the muscle *b*. Micro-scope.

In fig. 51. all the gastric muscles described in fig. 50. disappear, as well as those lateral and dorsal ones of which the letters are not to be found in this figure.

In the first ring are the gastric muscles, *e*, *f*, *g*, which are best seen here: the first is narrow and long, passing under and crossing *f*: one of its insertions is at the lower line, the other at the lateral, between the spiraculum and neck: *f* is short, broad, and nearly straight, placed along the intermediate line; but between it and the lateral it passes under *c*, and is fixed to the fold of the skin which goes from the one bag to the other; the lower insertion is near the second division. There are sometimes three muscles of those marked *g*, and sometimes four: the lower parts of them are fixed about the middle of the ring, and the anterior parts at the fold of the skin near the neck. The muscles *i* and *h* are fixed to the same fold; the other end of *h* being fixed under the muscle H, near the spiraculum. Above the upper end of *f*, a muscular body, *g*, may be seen. It is formed by the separation of two floating muscles.

The second ring has six gastric muscles, *k*, *l*, *m*, *n*, *o*, *p*. The first is a large oblique muscle, with three or four divisions placed at the anterior part of the ring. the head is fixed between the inferior line and its intermediate one, at the fold of the second division; from whence it crosses the inferior line and its corresponding muscle, terminating to the right and left of the line. I is a narrow muscle, whose head is fixed to the fold of the second division; the tail of it lying under *n*, and fastened to the edge of the skin that forms the cavity for the leg. The two muscles marked *m* have the same obliquity, and are placed the one on the other; the head is inserted in the skin under the muscle β, and communicates by a number of fibres with the tail of the muscle γ; the other end is fixed to the intermediate inferior line at the fold of the third division. The large and broad muscle *n*, covers the lower edge of the cavity of the limb, and the extremity of the tail of *l*. It is fixed first at the skin, near the intermediate line, from whence it goes in a perpendicular direction towards *m*, and introduces itself under *o* and *m*, where it is fixed. The muscle *o* is narrow and bent, and covers the edge of the cavity of the leg for a little way; one end terminating there, and the other finishing at the third division near *m*. That marked *p* is also bent: it runs near the anterior edge of the cavity of the leg; one end meets the head of *o*, the other end terminates at a raised fold near the inferior line. There is a triangular muscle on the side of the lateral muscle *o*, similar to that marked *g* in the following ring; in this figure it is entirely concealed by the muscle *m*.

The third ring has no muscle similar to *m*; that marked *k* differs only from that of the second ring in being crossed by the opposite muscle. Those marked *l*, *n*, *o*, *p*, are similar to those of the preceding one. The muscle *q* is triangular; the base is fastened to the last fold of the ring; on the lower side it is fixed to the muscle *o*, the top to the skin at the edge of the cavity for the leg.

Microscope.

The eight following rings have the gastric muscles, *i*, *k*, *l*, and *m*. The muscle *i* is quite straight, and placed at some distance from the inferior line: it is broad at the fourth ring, but diminishes gradually in breadth to the 11th. In the fourth it is united; but divides into two heads, which divaricate in the following rings. In the six next rings these heads are fixed nearly at the same place with *a* and *f*; and in the other two it terminates at the fold of the ring. The anterior insertion of the first and last is at the fold where the ring begins; that of the six others is somewhat lower under the place where the muscle *i* terminates. The lower part of the oblique muscle *k* is inserted in the skin near *i*; the upper part at the intermediate inferior muscle upon the fold which separates the following ring, but is wanting in the 11th. The muscle *l* is large, and co-operates with M: in the opening and shutting the spiraculum, one of its fixtures is near the intermediate inferior line, at about the same height as *i*. The tail terminates a little below the spiraculum.

The twelfth ring has only the single gastric muscle *d*, which is a bundle of six, seven, or eight muscles: the first fixture of these is at the subdivision of the ring near the inferior line: one or two cross this, and at the same time the similar muscles of the opposite side. Their fixture is at the bottom of the foot; and their office is to assist the muscle *a* in bringing back the foot, and to loosen the claw from what it lays hold of. One of the insertions of this muscle *a* is observed in this figure near *d*, the other near the subdivision of the ring.

Fig. 52, 53. Fig. 52. and 53. show the organization of the head of the cossus, though in a very imperfect manner, as M. Lyonet found it necessary to employ *twenty* figures to explain it fully. The head is represented as it appears when separated from the fat, and disengaged from the neck. HH are the two palpi. The truncated muscles D belong to the lower lip, and assist moving it. K shows the two ganglions of the neck united. H are the two vessels which assist in spinning the silk. L, the œsophagus. M, the two dissolving vessels. The Hebrew characters דבכא show the continuation of the four cephalic arteries. In fig. 52. the ten abductor muscles of the jaw are represented by SS, TT, VV, and Z. Four occipital muscles are seen in fig. 53. under *c c* and *f f*. At *a k* is represented a nerve of the first pair belonging to the ganglion of the neck; *b* is a branch of this nerve.

Fig. 54. Fig. 54. exhibits the nerves as seen from the under part; but excepting in two or three nerves, which may be easily distinguished, only one of each pair is drawn, in order to avoid confusion. The nerves of the first ganglion of the neck are marked by capital letters, those of the ganglion (a) of the head by Roman letters; the nerves of the small ganglion by Greek characters. Those of the frontal ganglion, except one, by numbers.

The muscles of the cossus have neither the colour nor form of those of larger animals. In their natural state they are soft, and of the consistence of a jelly. Their colour is a grayish blue, which, with the silver-coloured appearance of the pulmonary vessels, form a glorious spectacle. After the caterpillar has been soaked for some time in spirit of wine, they lose their elasticity and transparency, becoming firm, opaque, and white, and the air-vessels totally disappear. The number of muscles in a caterpillar is very great. The greatest part of the head is composed of them, and there is a vast number about the œsophagus, intestines, &c.; the skin is, as it were, lined by different beds of them, placed the one under the other, and ranged with great symmetry. M. Lyonet has been able to distinguish 228 in the head, 1647 in the body, and 2066 in the intestinal tube, making in all 3941.

Microscope.

At first sight the muscles might be taken for tendons, as being of the same colour, and having nearly the same lustre. They are generally flat, and of an equal size throughout; the middle seldom differing either in colour or size from either of the extremities. If they are separated, however, by means of very fine needles, in a drop of some fluid, we find them composed not only of fibres, membranes, and air-vessels, but likewise of nerves; and, from the drops of oil that may be seen floating on the fluid, they appear also to be furnished with many unctuous particles. Their ends are fixed to the skin, but the rest of the muscle is generally free and floating. Several of them branch out considerably; and the branches sometimes extend so far, that it is not easy to discover whether they are distinct and separate muscles or parts of another. They are moderately strong; and those which have been soaked in spirit of wine, when examined by the microscope, are found to be covered with a membrane which may be separated from them; and they appear then to consist of several parallel bands lying longitudinally along the muscle, which, when divided by means of fine needles, appear to be composed of still smaller bundles of fibres lying in the same direction; which, when examined by a powerful magnifier, and in a favourable light, appear twisted like a small cord. The muscular fibres of the spider, which are much larger than those of the caterpillar, consist of two different substances, one soft and the other hard; the latter being twisted round the former spirally, and thus giving it the twisted appearance just mentioned.

There is nothing in the caterpillar similar to the brain in man. We find indeed in the head of this insect a part from which all the nerves seem to proceed; but this part is entirely unprotected, and so small, that it does not occupy one-fifth part of the head; the surface is smooth, and has neither lobes nor any anfractuosity like the human brain. But if we call this a brain in the caterpillar, we must say that it has *thirteen:* for there are twelve other such parts following each other in a straight line, all of them of the same substance with that in the head, and nearly of the same size; and from them, as well as from that in the head, the nerves are distributed through the body.

The spinal marrow in the cossus goes along the belly; is very small, forking out at intervals, nearly of the same thickness throughout, except at the ganglions, and is not enclosed in any case. It is by no means so tender as in man; but has a great degree of tenacity, and does not break without a considerable degree of tension. The substance of the ganglion differs from that of the spinal marrow, as no vessels can be discovered in the latter; but the former

Microscope.

mer are full of very delicate ones. There are 94 principal nerves, which divide into inumerable ramifications.

The eossus has two large trachcal arteries, creeping under the skin close to the spiracula: one at the right and the other at the left side of the insect, each of them communieating with the air by means of nine spiracula. They are nearly as long as the whole caterpillar; beginning at the first spiraculum, and extending somewhat farther than the last; some branches also extending quite to the extremity of the body. Round each spiraculum the trachea pushes forth a great number of branches, which are again divided into smaller ones, and these further subdivided and spread through the whole body of the caterpillar. The tracheal artery, with all its numerous ramifications, are open elastic vessels, which may be pressed close together, or drawn out eonsiderably, but return immediately to their usual size when the tension ceases. They are naturally of a silver colour, and make a beautiful appearance. This vessel, with its principal branches, is composed of three coats, which may be separated from one another. The outmost is a thick membrane furnished with a great variety of fibres, which describe a vast number of circles round it, communicating with each other by numerous shoots. The second is very thin and transparent, without any particular vessel being distinguishable in it. The third is composed of scaly threads, generally of a spiral form; and so near each other as scarcely to leave any interval. They are curiously united with the membrane which occupies the intervals; and form a tube which is always open, notwithstanding the flexure of the vessel. There are also many other peculiarities in its structure. The principal tracheal vessels divide into 1326 different branches.

The heart of the eossus is very different from that of larger animals, being almost as long as the animal itself. It lies immediately under the skin at the top of the back, entering the head, and terminating near the mouth. Towards the last rings of the body it is large and capacious, diminishing very much as it approaches the head, from the fourth to the twelfth division. On both sides, at each division, it has an appendage, which partly covers the muscles of the back, but which, growing narrower as it approaches the lateral line, it forms a number of irregular lozenge-shaped bodies.—This tube, however, seems to perform none of the functions of the heart in larger animals, as we find no vessel opening into it which answers either to the aorta or vena cava. It is called the heart, because it is generally filled with a kind of lymph, which naturalists have supposed to be the blood of the caterpillar; and because in all caterpillars which have a transparent skin, we may perceive alternate regular contractions and dilatations along the superior line, beginning at the eleventh ring, and proceeding from ring to ring, from the fourth; whence this vessel is thought to be a string or row of hearts. There are two white oblong bodies which join the heart near the eighth division; and these have been called *reniform* bodies, from their having somewhat of the shape of a kidney.

The most considerable part of the whole caterpillar with regard to bulk is the corpus crassum. It is the first and only substance that is seen on opening it. It forms a kind of sheath which envelopes and covers all the entrails, and, introducing itself into the head, enters all the muscles of the body, filling the greatest part of the empty spaces in the caterpillar. It very much resembles the configuration of the human brain, and is of a milk-white colour.

Microscope.

The œsophagus descends from the bottom of the mouth to about the fourth division. The fore part, which is in the head, is fleshy, narrow, and fixed by different muscles to the crustaceous parts of it; the lower part, which passes into the body, is wider, and forms a kind of membranaceous bag, covered with very small muscles; near the stomach it is narrower, and, as it were, confined by a strong nerve fixed to it at distant intervals. The ventricle begins a little above the fourth division, where the œsophagus ends, and finishes at the tenth. It is about seven times as long as broad; and the anterior part, which is broadest, is generally folded. These folds diminish with the bulk as it approaches the intestines; the surface is covered with a great number of aërial vessels, and opens into a tube, which M. Lyonet calls the large intestine.—There are three of these large tubes, each of which differs so much from the rest, as to require a particular name to distinguish it from them.

The two vessels from which the eossus spins its silk are often above three inches long, and are distinguished into three parts; the anterior, intermediate, and posterior. It has likewise two other vessels, which are supposed to prepare and contain the liquor for dissolving the wood on which it feeds.

Fig. 55. shows the wing of an earwig magnified; *a* represents it of the natural size. The wings of this insect are so artificially folded up under short cases, that few people imagine they have any. Indeed, they very rarely make use of their wings. The cases under which they are concealed are not more than a sixth part of the size of one wing, though a small part of the wing may be discovered, on a careful inspection, projecting from under them. The upper part of the wing is crustaceous and opaque, but the under part is beautifully transparent. In putting up their wings, they first fold back the parts AB, and then shut up the ribs like a fan; the strong muscles used for this purpose being seen at the upper part of the figure. Some of the ribs are extended from the centre to the outer edge; others only from the edge about half way: but they are all united by a kind of band, at a small but equal distance from the edge; the whole evidently contrived to strengthen the wing, and facilitate its various motions. The insect itself differs very little in appearance in its three different states. De Geer asserts, that the female hatches eggs like a hen, and broods over her young ones as a hen does. Plate CCCXLIV. Fig. 55.

Fig. 56. represents a wing of the *hemerobius perla* magnified. It is an insect which seldom lives more than two or three days.—The wings are nearly of a length, and exactly similar to one another. They are composed of fine delicate nerves, regularly and elegantly disposed as in the figure, beautifully adorned with hairs, and lightly tinged with green. The body is of a fine green colour; and its eyes appear like two burnished beads of gold, whence it has obtained the name of *golden eye*. This insect lays its eggs on the leaves of the plum or the rose tree; the eggs are of a white Fig. 56.

colour,

Micro-scope. colour, and each of them fixed to a little pedicle or foot-stalk, by which means they stand off a little from the leaf, appearing like the fructification of some of the mosses. The larva proceeding from these eggs resembles that of the coccinella or lady-cow, but is much more handsome. Like that, it feeds upon aphides or pucerons, sucking their blood, and forming itself a case with their dried bodies; in which it changes into the pupa state, from whence they afterwards emerge in the form of a fly.

Fig. E, F, I, represent the dust of a moth's wing magnified. This is of different figures in different moths. The natural size of these small plumes is represented at H.

Fig. 57. Fig. 57. shows a part of the cornea of the libellula magnified. In some positions of the light, the sides of the hexagons appear of a fine gold colour, and divided by three parallel lines. The natural size of the part magnified is shown at *b*.

Fig. 58. Fig. 58. shows the part *c* of a lobster's cornea magnified.

Fig. 59. Fig. 59. shows one of the arms or horns of the lepas anatifera, or barnacle, magnified; its natural size being represented at *d*. Each horn consists of several joints, and each joint is furnished on the concave side of the arm with long hairs. When viewed in the microscope, the arms appear rather opaque; but they may be rendered transparent, and become a most beautiful object, by extracting out of the interior cavity a bundle of longitudinal fibres, which runs the whole length of the arm. Mr Needham thinks that the motion and use of these arms may illustrate the nature of the rotatory motion in the wheel-animal. In the midst of the arms is an hollow trunk, consisting of a jointed hairy tube, which encloses a long round tongue that can be pushed occasionally out of the tube or sheath, and retracted occasionally. The mouth of the animal consists of six laminæ, which go off with a bend, indented like a saw on the convex edge, and by their circular disposition are so ranged, that the teeth, in the alternate elevation and depression of each plate, act against whatever comes between them. The plates are placed together in such a manner, that to the naked eye they form an aperture not much unlike the mouth of a contracted purse.

Plate CCCXLV. fig. 60. Fig. 60. shows the apparatus of the *tabanus* or gad-fly, by which it pierces the skin of horses and oxen, in order to suck the blood. The whole is contained in a fleshy case, not expressed in the figure. The feelers *a a* are of a spongy texture and gray coloured, covered with short hairs. They are united to the head by a small joint of the same substance. They defend the other parts of the apparatus, being laid upon it side by side whenever the animal stings, and thus preserve it from external injury. The wound is made by the two lancets *b b* and B, which are of a delicate structure, but very sharp, formed like the dissecting knife of an anatomist, growing gradually thicker to the back.—The two instruments *c c* and C, appear as if intended to enlarge the wound, by irritating the parts round it; for which they are jagged or toothed. They may also serve, from their hard and horny texture, to defend the tube *e* E, which is of a softer nature, and tubular to admit the blood, and convey it to the stomach. This part is totally enclosed in a line *d* D, which entirely covers it. These parts are drawn separately at B, C, D, E. De Geer observes, that only the females suck the blood of animals; and Reaumur informs us, that having made one, that had sucked its fill, disgorge itself, the blood it threw up appeared to him to be more than the whole body of the insect could have contained. The natural size of this apparatus is shown at *f*. Micro-scope, Midas.

Fig. 61. shows a bit of the skin of a lump-fish (*cyclopterus*) magnified. When a good specimen of this can be procured, it forms a most beautiful object. The tubercles exhibited in the figure probably secrete an unctuous juice. Fig. 61.

Fig. 62. shows the scale of a sea perch found on the English coast; the natural size is exhibited at *h*. Fig. 62.

Fig. 63. the scale of an haddock magnified; its natural size as within the circle. Fig. 63.

Fig. 64. the scale of a parrot fish from the West Indies magnified; *l* the natural size of it. Fig. 64.

Fig. 65. the scale of a kind of perch in the West Indies magnified; *k* the natural size of the scale. Fig. 65.

Fig. 66. part of the skin of a sole fish, as viewed through an opaque microscope; the magnified part in its real size, shown at *l*. Fig. 66.

The scales of fishes afford a great variety of beautiful objects for the microscope. Some are long; others round, square, &c. varying considerably not only in different fishes, but even in different parts of the same fish. Leeuwenhoeck supposed them to consist of an infinite number of small scales or strata, of which those next to the body of the fish are the largest. When viewed by the microscope, we find some of them ornamented with a prodigious number of concentric flutings, too near each other, and too fine, to be easily enumerated. These flutings are frequently traversed by others diverging from the centre of the scale, and generally proceeding from thence in a straight line to the circumference.

For more full information concerning these and other microscopical objects, the reader may consult Mr Adams's *Essays on the Microscope*, who has made the most valuable collection that has yet appeared on the subject. See also the articles ANIMALCULE, CRYSTALLIZATION, POLYPE, PLANTS, and WOOD, in the present work.

MIDAS, in fabulous history, a famous king of Phrygia, who having received Bacchus with great magnificence, that god, out of gratitude, offered to grant him whatever he should ask. Midas desired that every thing he touched should be changed into gold. Bacchus consented; and Midas, with extreme pleasure, everywhere found the effects of his touch. But he had soon reason to repent of his folly: for wanting to eat and drink, the aliments no sooner entered his mouth than they were changed into gold. This obliged him to have recourse to Bacchus again, to beseech him to restore him to his former state; on which the god ordered him to bathe in the river Pactolus, which from thenceforward had golden sands. Some time after, being chosen judge between Pan and Apollo, he gave another instance of his folly and bad taste, in preferring Pan's music to Apollo's; on which the latter being enraged, gave him a pair of asses ears. This Midas attempted to conceal from the knowledge of his subjects: but one of his servants saw the length of his ears, and being unable to keep the secret, yet afraid to reveal

MICROSCOPE. PLATE CCXXXVII.

Fig. 1.

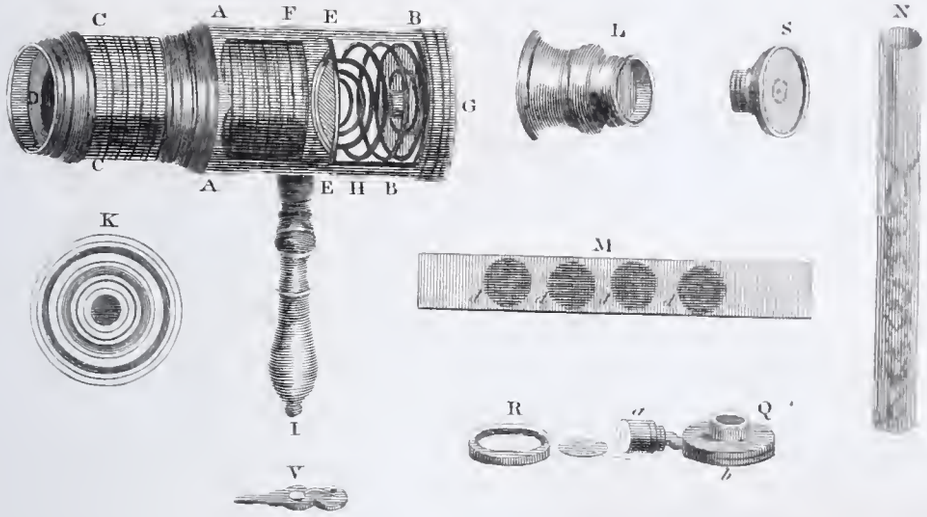


Fig. 2.



Fig. 7.

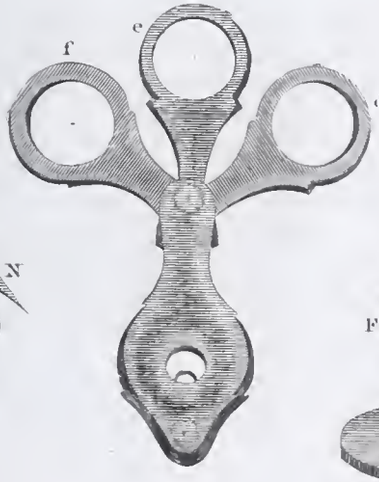


Fig. 3.

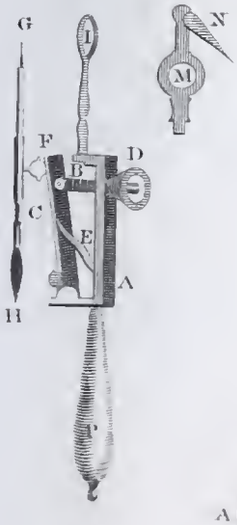


Fig. 4.

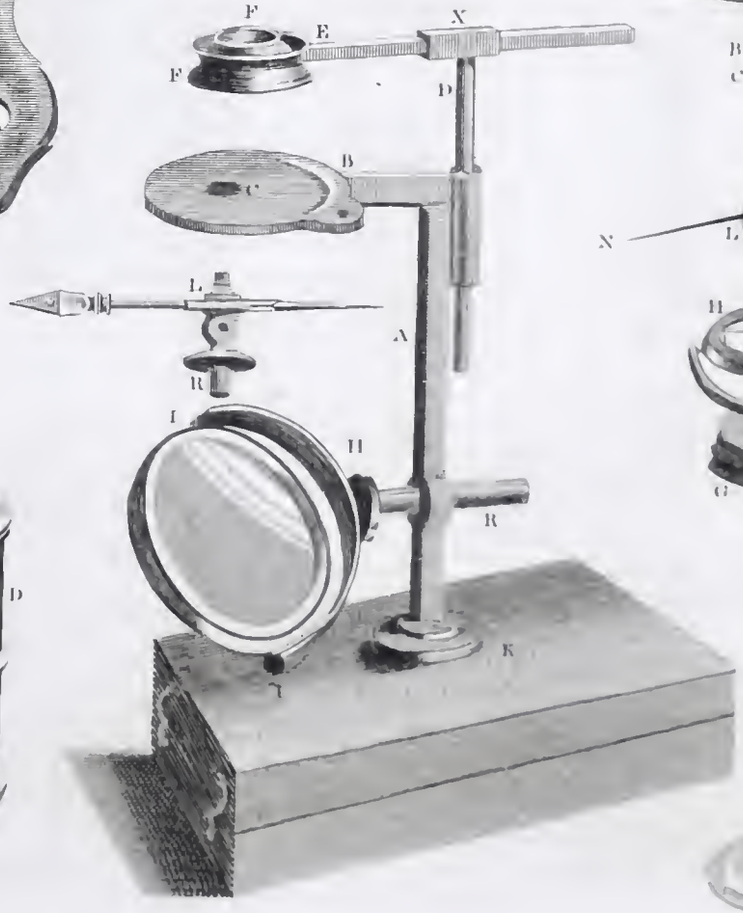


Fig. 5.

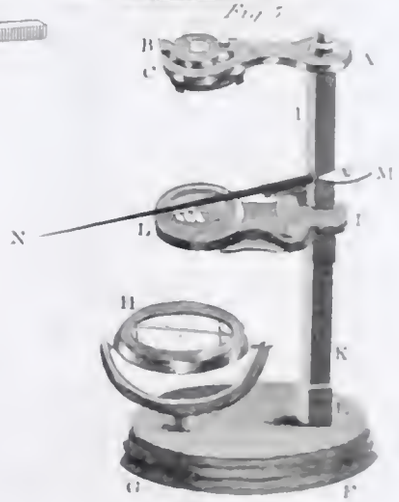


Fig. 6.

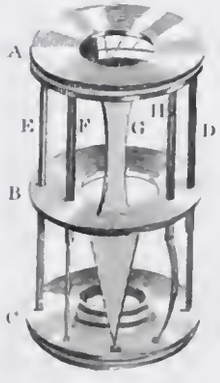






Fig. 8.

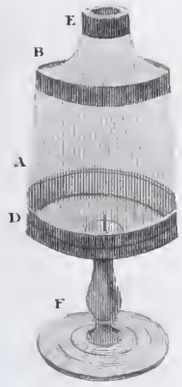


Fig. 9

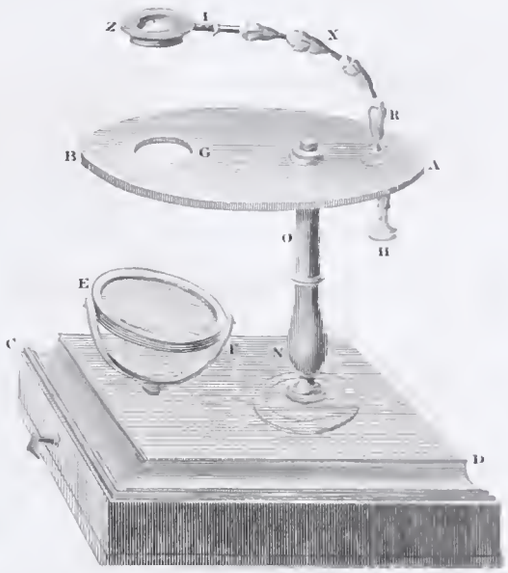


Fig. 10

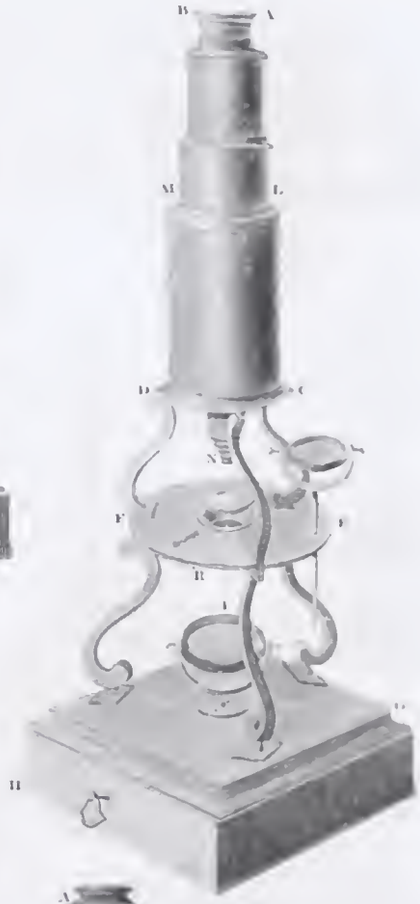


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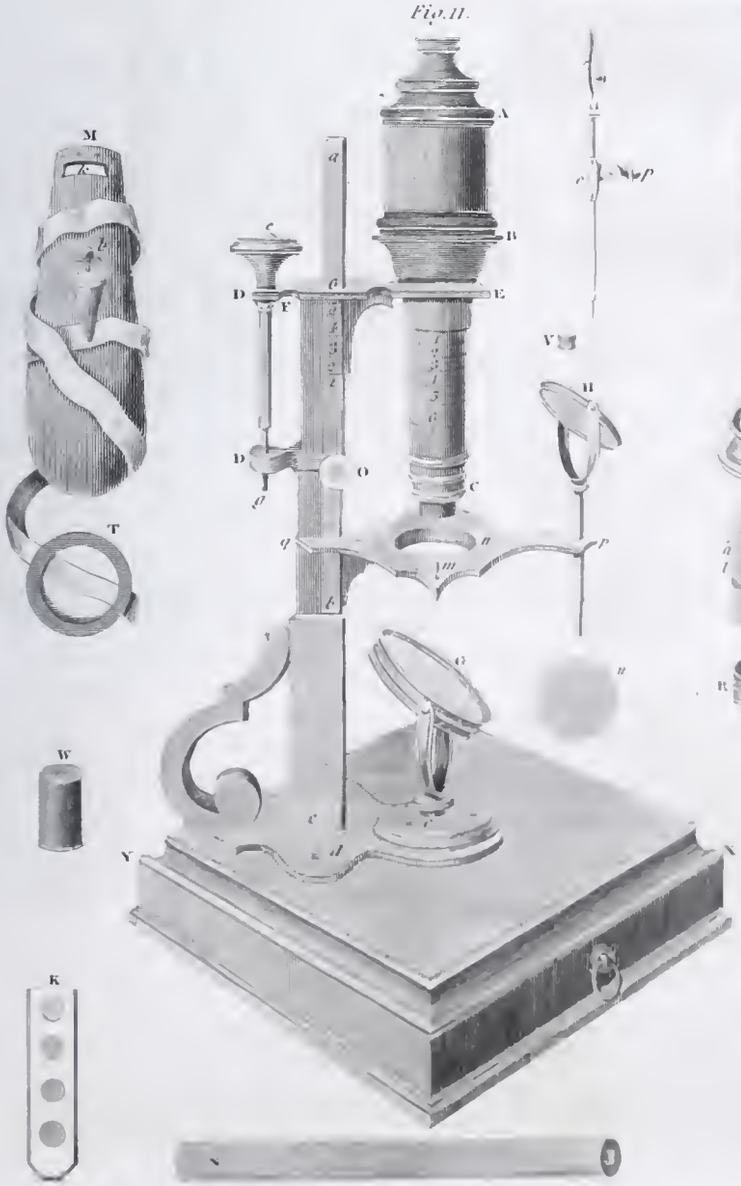
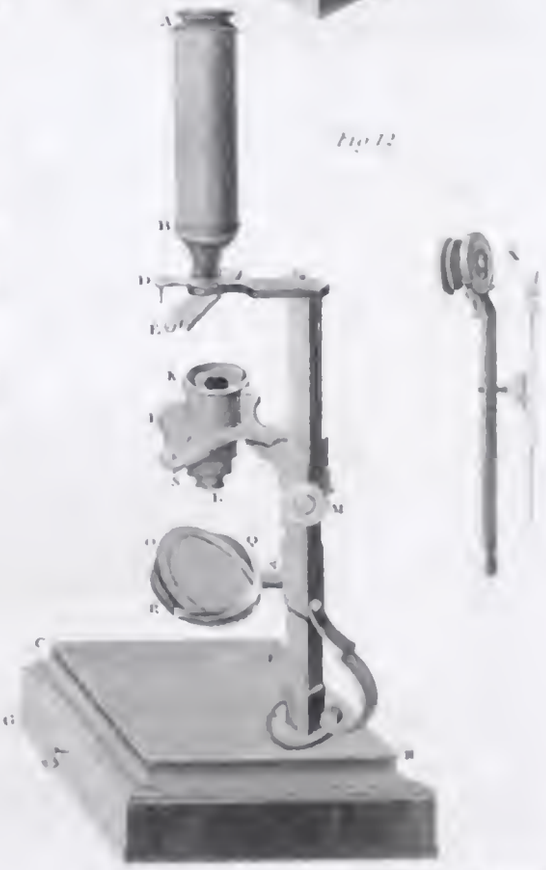


Fig. 12



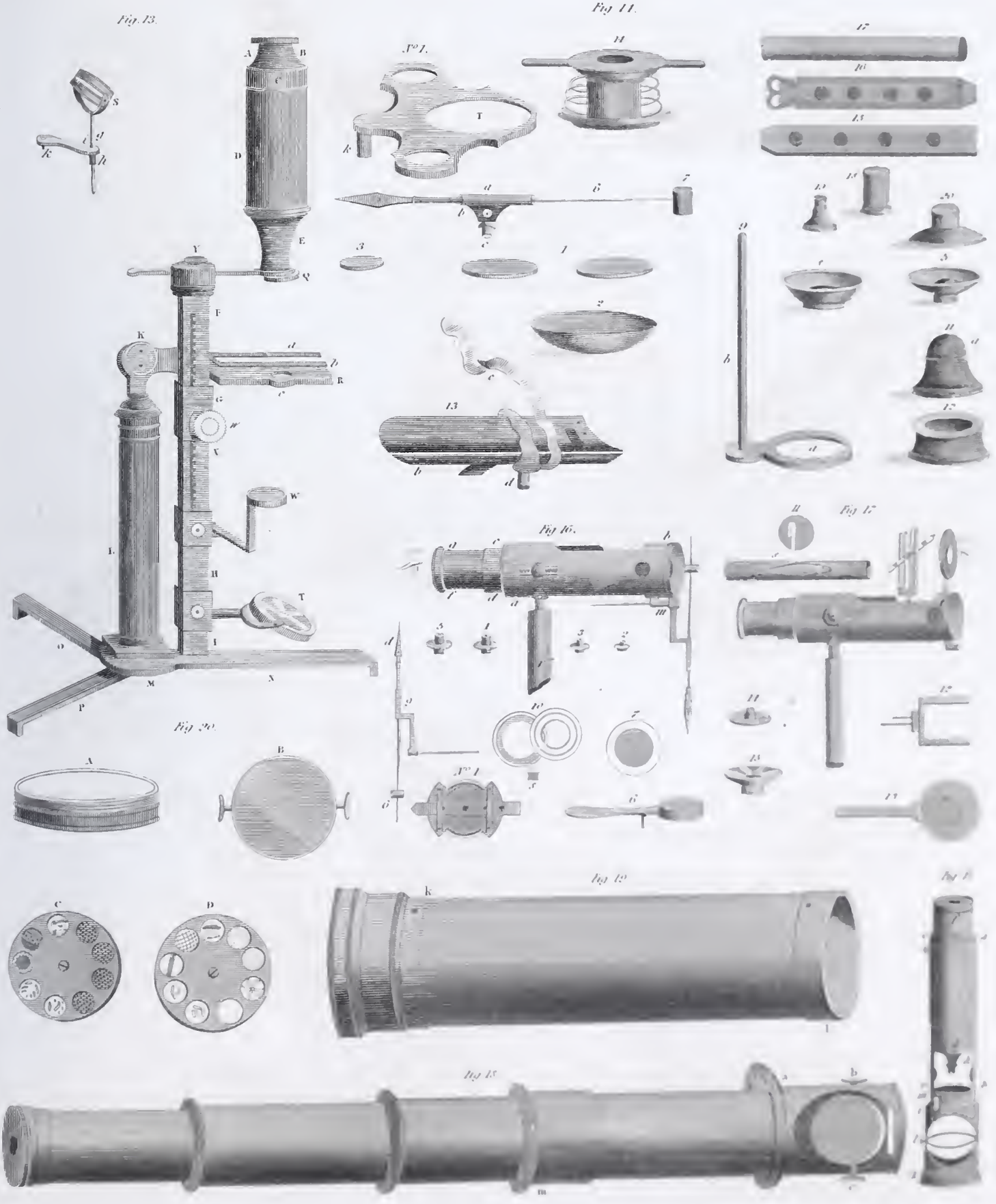

Fig. 13.
Fig. 11.
Fig. 16.
Fig. 17.
Fig. 20.
Fig. 12
Fig. 14
Fig. 18

Fig. 21.

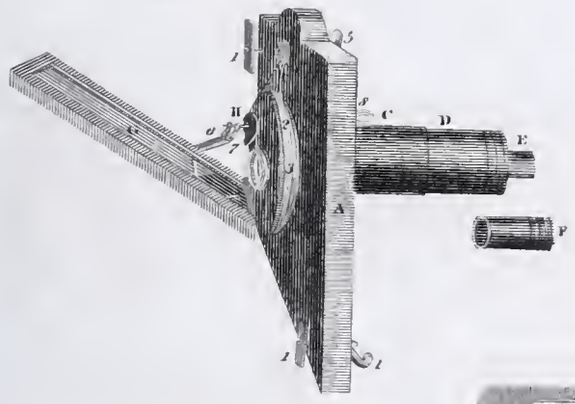
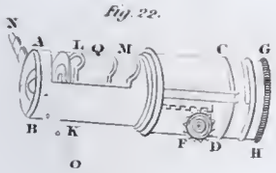


Fig. 23.



Fig. 22.





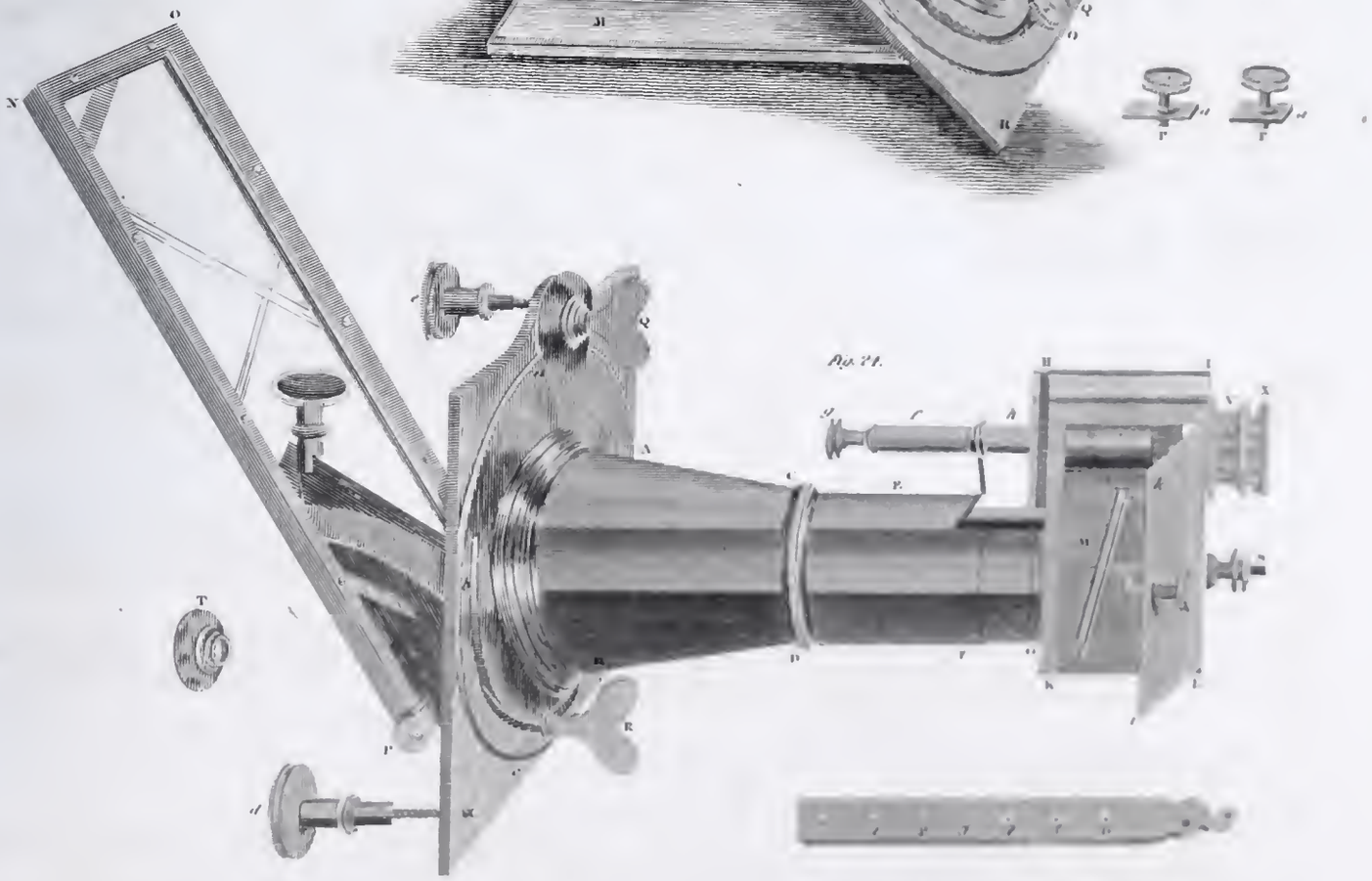


Fig. 24.

MICROSCOPE.

PLATE CCXLI.

Fig. 26.

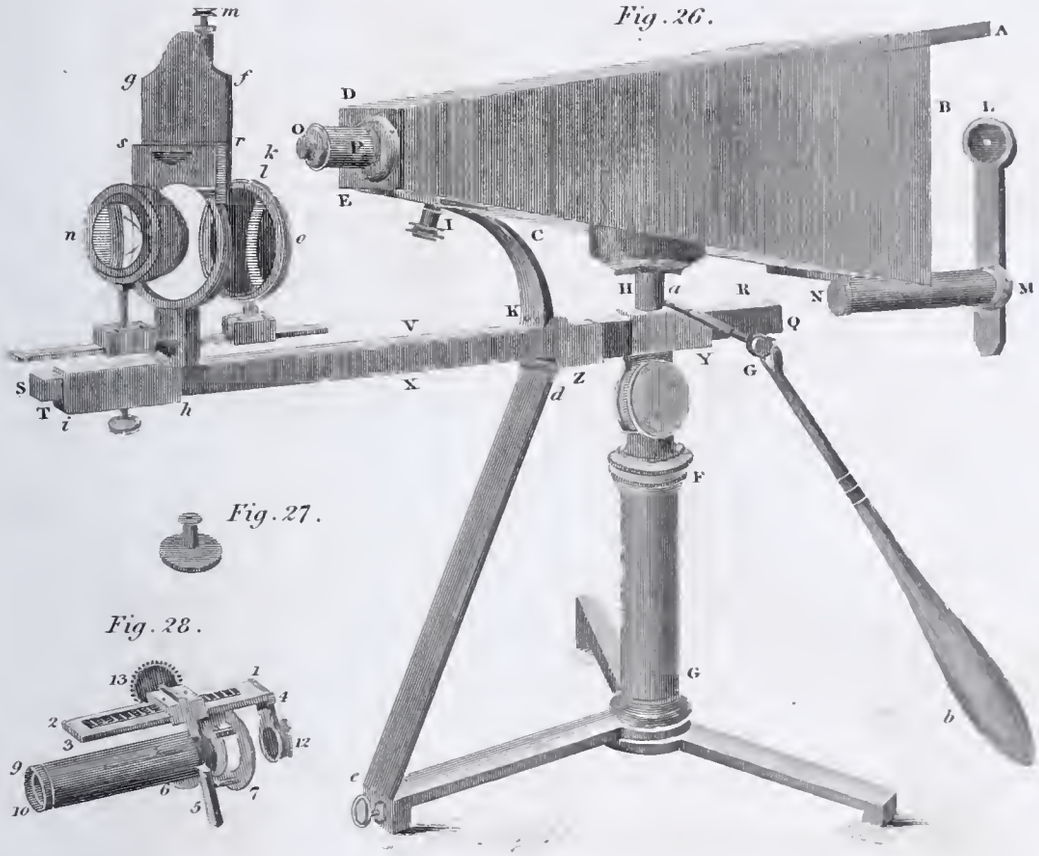


Fig. 27.

Fig. 28.

Fig. 29.



Fig. 30.

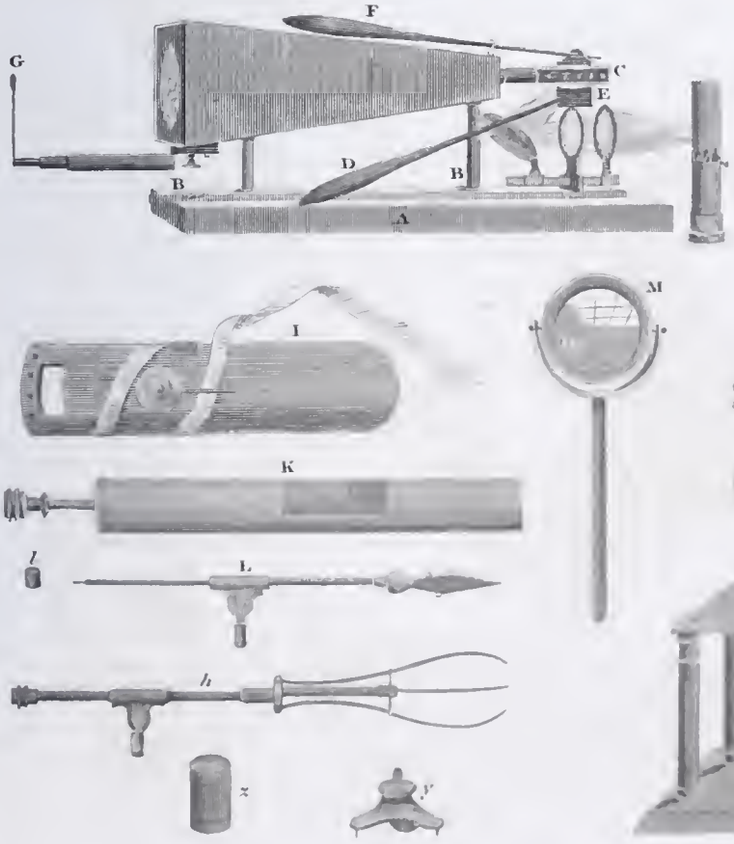


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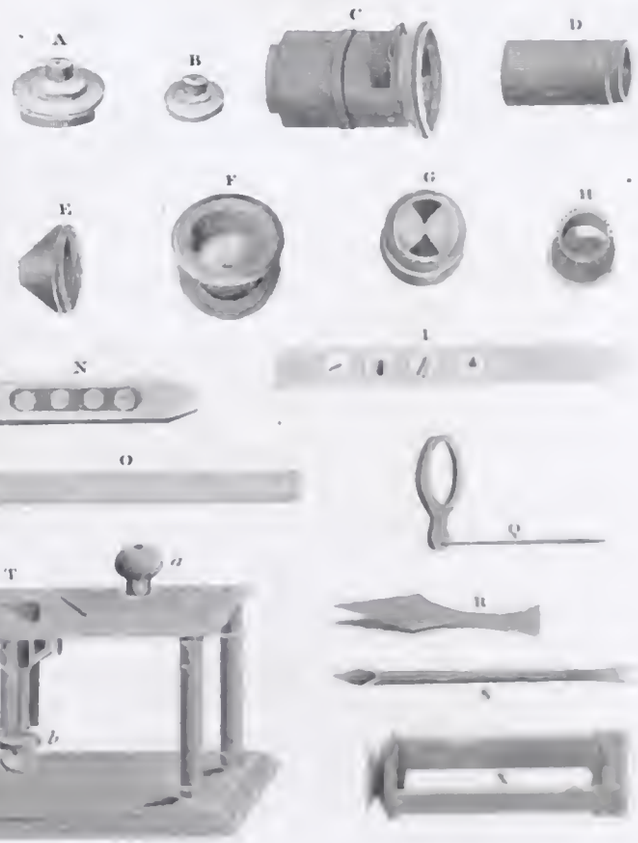




Fig. 33.

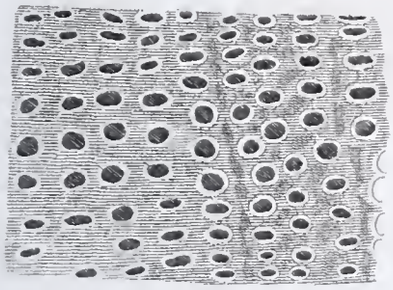


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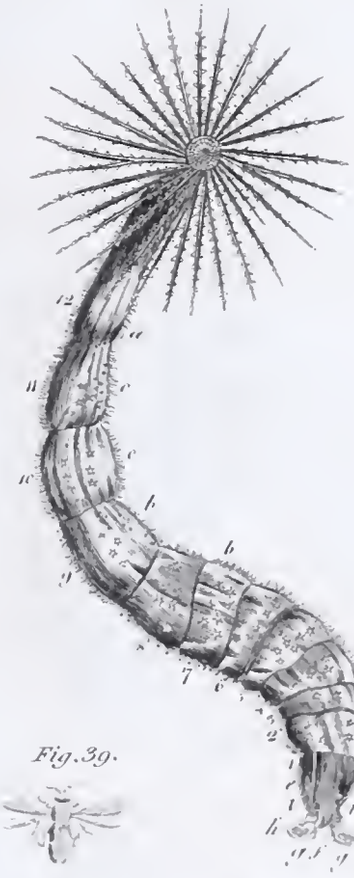


Fig. 32.



Fig. 35.



Fig. 36.



Fig. 39.

Fig. 37.



Fig. 40.

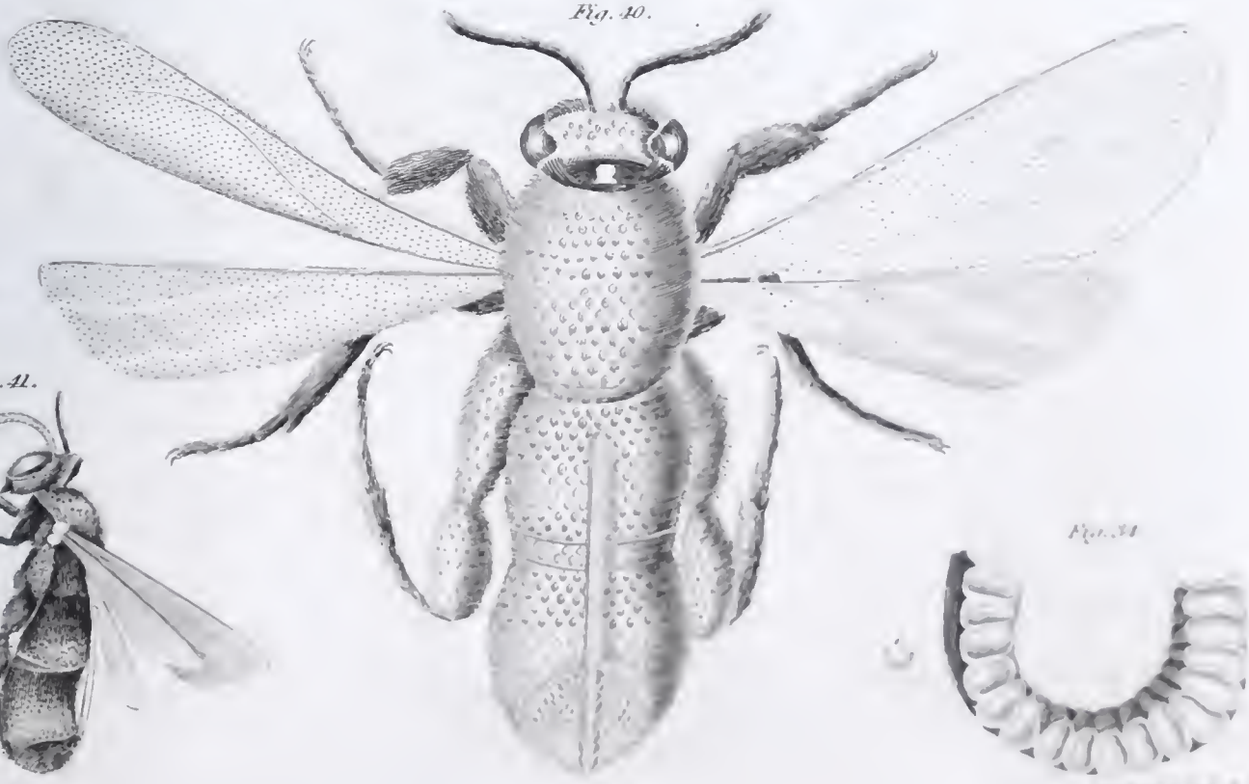


Fig. 41.

Fig. 34

Fig 54

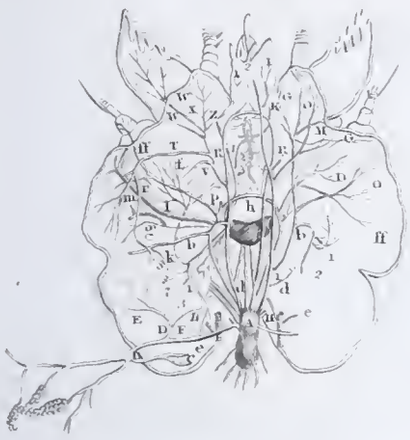


Fig 42

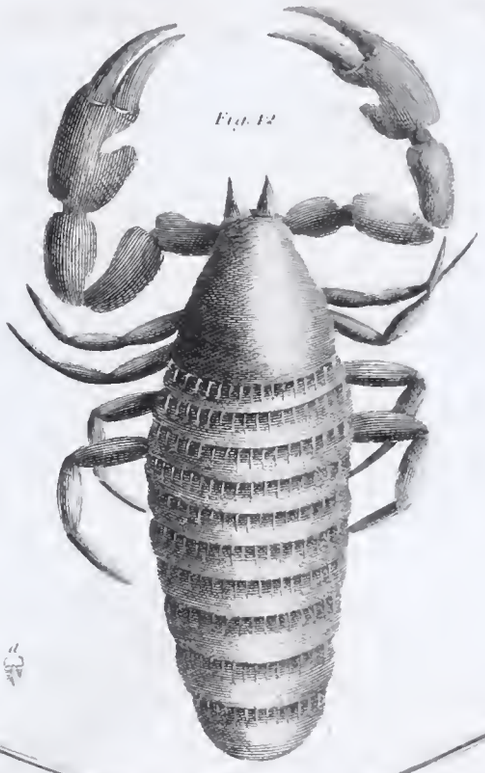


Fig 43



Fig 41



Fig 46

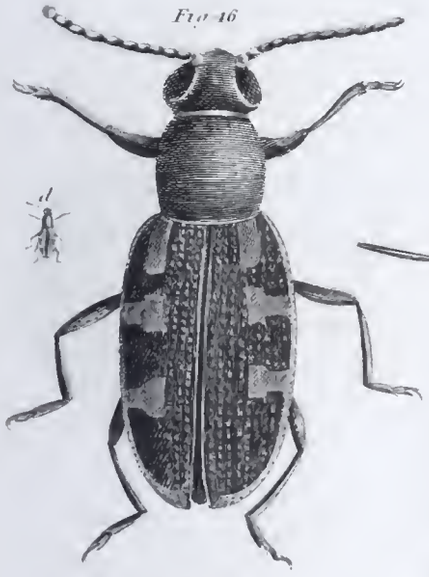


Fig 53

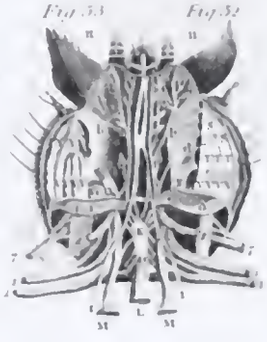


Fig 52

Fig 45

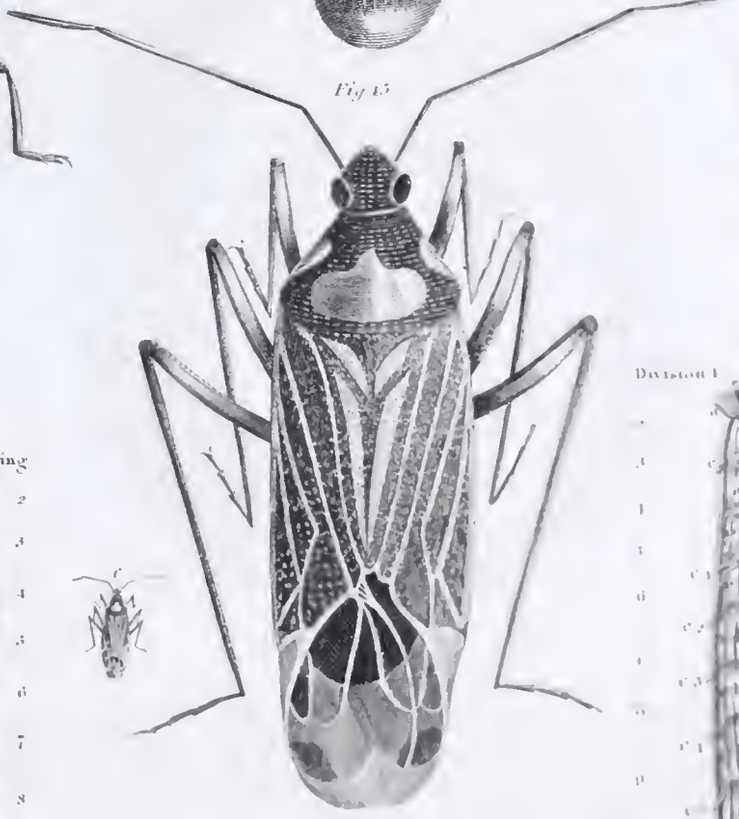


Fig 51.

Division I

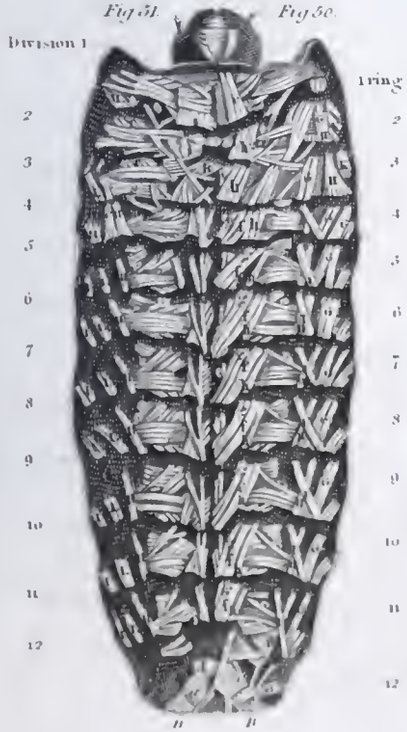


Fig 50.

1 ring

Fig 47

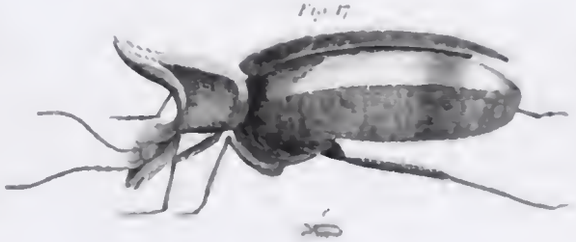


Fig 48

Division I

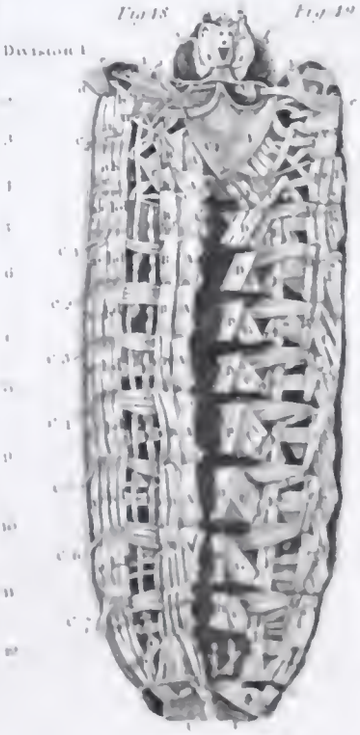


Fig 49

1 ring

MICROSCOPIC

OBJECTS.

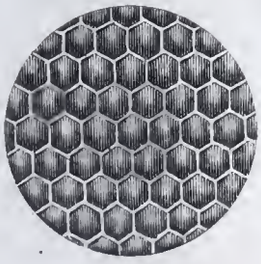
Fig. 55.



a



Fig. 57.



b

c

e

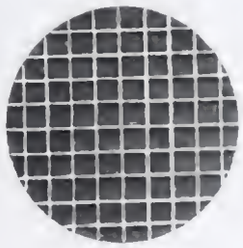


Fig. 59.



d

Fig. 58



f

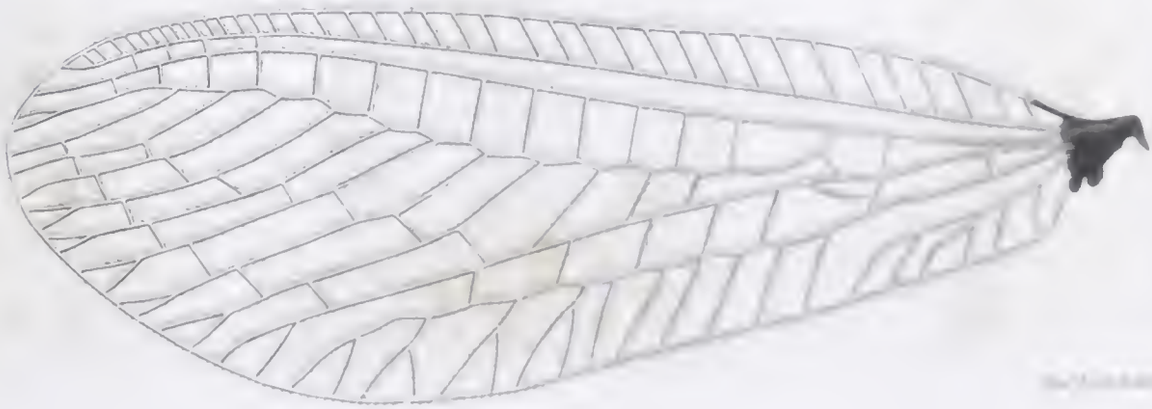


g



h

Fig. 56



MICROSCOPIC.

OBJECTS.

PLATE CCCXLV.

Fig. 62.



h

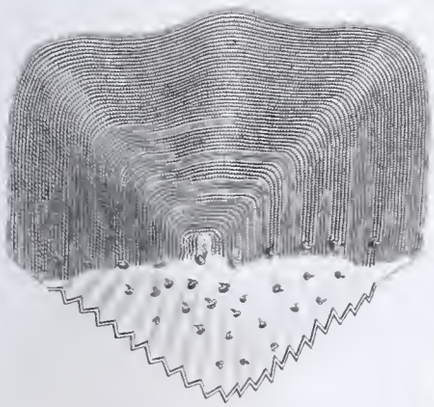


Fig. 63.



g

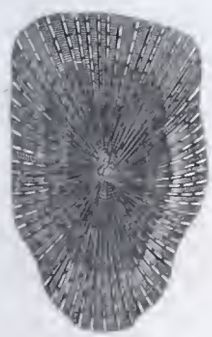
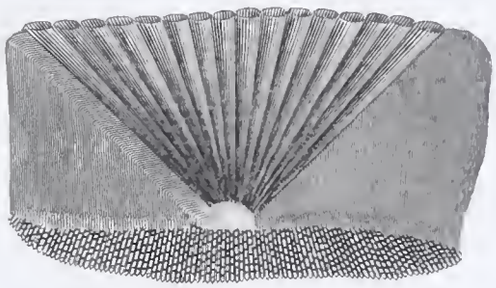




Fig. 65.



k

Fig. 61.

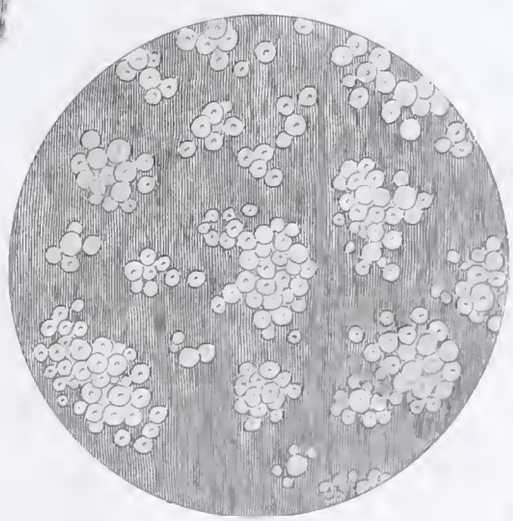


Fig. 60.

f

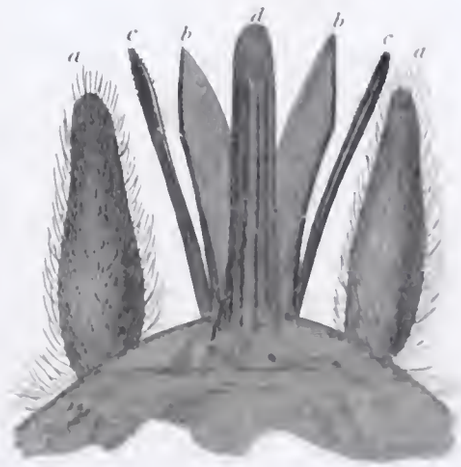


Fig. 64.



i

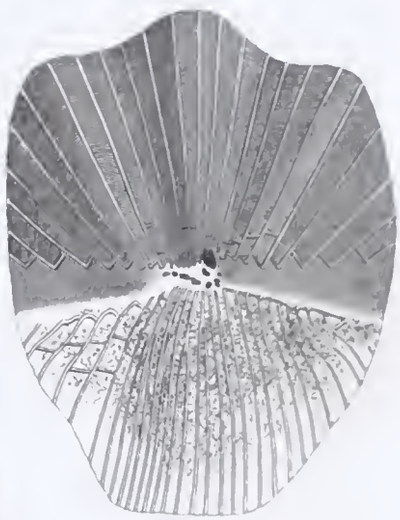


Fig. 66.



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Midas ‖ Middleburg.

veal it from apprehension of the king's resentment, he opened a hole in the earth, and after he had whispered there that Midas had the ears of an ass, he covered the place as before, as if he had buried his words in the ground. On that place, as the poets mention, grew a number of reeds, which when agitated by the wind uttered the same sound that had been buried beneath, and published to the world that Midas had the ears of an ass. Some explain the fable of the ears of Midas, by the supposition that he kept a number of informers and spies, who were continually employed in gathering every seditious word that might drop from the mouths of his subjects. Midas, according to Strabo, died of drinking bull's hot blood. This he did, as Plutarch mentions, to free himself from the numerous ill dreams which continually tormented him. Midas, according to some, was son of Cybele. He built a town which he called *Ancyræ*.

MIDAS, *Ear-shell.* See HALIOTIS, CONCHOLOGY *Index*.

MID-HEAVEN, the point of the ecliptic that culminates, or in which it cuts the meridian.

MIDDLEBURG, one of the Friendly islands in the South sea. The island was first discovered by Tasman, a Dutch navigator, in January 1642-3; and is called by the natives *Ea-Oo-whe:* it is about 16 miles from north to south, and in the widest part about 8 miles from east to west. The skirts are chiefly laid out in plantations, the south-west and north-west sides especially. The interior parts are but little cultivated, though very capable of it: but this neglect adds greatly to the beauty of the island; for here are agreeably dispersed groves of cocoa-nuts and other trees, lawns covered with thick grass, here and there plantations and paths leading to every part of the island, in such beautiful disorder, as greatly to enliven the prospect. The hills are low; the air is delightful; but unfortunately water is denied to this charming spot. Yams, with other roots, bananas, and bread fruit, are the principal articles of food; but the latter appeared to be scarce. Here is the pepper-tree, or *ava ava*, with which they make an intoxicating liquor, in the same disgusting manner as is practised in the Society islands. Here are several odoriferous trees and shrubs, particularly a species of the lemon tribe; and the botanical gentlemen met with various new species of plants. Here also are a few hogs and fowls.

There are no towns or villages; most of the houses are built in plantations, which are laid out in different parts, with no other order than what convenience requires. They are neatly constructed, but are less roomy and convenient than those in the Society isles. The floors are a little raised, and covered with thick strong mats. The same sort of matting serves to enclose them on the windward side, the others being open. They have little areas before most of them, which are planted round with trees or ornamental shrubs, whose fragrance perfumes the air. Their household furniture consists of a few wooden platters, cocoa-nut shells, and pillows made of wood, and shaped like four-footed stools or forms: their common clothing, with the addition of a mat, serves them for bedding.

The natives are of a clear mahogany or chesnut brown, with black hair, in short frizzled curls, which seems to be burnt at the tips; their beards are cut or shaven. The general stature of the men is equal to our middle size, from five feet three to five feet ten inches; the proportions of the body are very fine, and the *contours* of the limbs extremely elegant, though something more muscular than at Otaheite, which may be owing to a greater and more constant exertion of strength in their agriculture and domestic economy. Their features are extremely mild and pleasing; and differ from the old Otaheitan faces in being more oblong than round, the nose sharper, and the lips rather thinner. The women are, in general, a few inches shorter than the men, but not so small as the lower class of women at the Society islands. The practice of puncturing the skin, and blacking it, which is called *tattowing*, is in full force among the men here, for their belly and loins are very strongly marked in configurations more compounded than those at Otaheite. The tenderest parts of the body were not free from these punctures; the application of which, besides being very painful, must be extremely dangerous on glandulous extremities. Middleburg.

The men in general go almost naked, having only a small piece of cloth round the loins, but some wrap it in great abundance round them from their waist: this cloth is manufactured much like that at Otaheite, but overspread with a strong glue, which makes it stiff, and fit to resist the wet. The women are likewise covered from the waist downwards: they often have loose necklaces, consisting of several strings of small shells, seeds, teeth of fishes; and in the middle of all, the round *operculum*, or cover of a shell as large as a crown-piece. The men frequently wear a string round their necks, from which a mother-of-pearl shell hangs down on the breast; both the ears of the women were perforated with two holes, and a cylinder cut out of tortoise-shell or bone was stuck through both the holes. The most remarkable circumstance observed of this people was, that most of them wanted the little finger on one, and sometimes on both hands: the difference of sex or age did not exempt them from this amputation; for even among the few children that were seen running about naked, the greater part had already suffered such loss. This circumstance was observed by Tasman. Another singularity which was observed to be very general among these people, was a round spot on each cheek-bone, which appeared to have been burnt or blistered. On some it seemed to have been recently made, on others it was covered with scurf, and many had only a slight mark of its former existence: how, or for what purpose it was made, could not be learnt. The women here, in general, were reserved; and turned, with disgust, from the immodest behaviour of ungovernable seamen: there were not, however, wanting some who appeared to be of easy virtue, and invited their lovers with lascivious gestures. The language spoken here is soft, and not unpleasing; and whatever they said was spoken in a kind of singing tone. Omai and Mahine, who were both passengers on board the ship, at first declared that the language was totally new and unintelligible to them; however the affinity of several words being pointed out, they soon caught the particular modification of this dialect, and conversed much better with the natives than any on board the ships could have done, after a long intercourse. They have the neat-

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Middleburg, Middleham.

est ornaments imaginable, consisting of a number of little flat sticks, about five inches long, of a yellow wood like box, firmly and elegantly connected together at the bottom by a tissue of the fibres of cocoanut, some of which were of their natural colour, and others dyed black; the same fibres were likewise used in the making of baskets, the taste of which was highly elegant, and varied into different forms and patterns. Their clubs are of a great variety of shapes, and many of them so ponderous as scarcely to be managed with one hand. The most common form was quadrangular, so as to make a rhomboid at the broad end, and gradually tapering into a round handle at the other. Far the greater part were carved all over in many chequered patterns, which seemed to have required a long space of time, and incredible patience, to work up; as a sharp stone, or a piece of coral, are the only tools made use of: the whole surface of the plain clubs was as highly polished as if an European workman had made them with the best instruments: Besides clubs, they have spears of the same wood, which were sometimes plain sharp-pointed sticks, and sometimes barbed with a sting-ray's tail. They have likewise bows and arrows of a peculiar construction; the bow, which is six feet long, is about the thickness of a little finger, and when slack, forms a slight curve; its convex part is channelled with a single deep groove, in which the bow-string is lodged. The arrow is made of reed, near six feet long, and pointed with hard wood: when the bow is to be bent, instead of drawing it so as to increase the natural curvature, they draw it the contrary way, make it perfectly straight, and then form the curve on the other side. Most of their canoes have outriggers, made of poles; and their workmanship is very admirable: two of these canoes are joined together with a surprising exactness, and the whole surface receives a very curious polish. Their paddles have short broad blades, something like those at Otaheite, but more neatly wrought and of better wood.

They keep their dead above ground, after the manner of the Society islands; as a corpse was seen deposited on a low hut.

Here were seen several men and women afflicted with leprous diseases, in some of whom the disorder had risen to a high degree of virulence: one man in particular had his back and shoulders covered with a large cancerous ulcer, which was perfectly livid within, and of a bright yellow all round the edges. A woman was likewise unfortunate enough to have her face destroyed by it in the most shocking manner; there was only a hole left in the place of her nose; her cheek was swelled up, and continually oozing out a purulent matter: and her eyes seemed ready to fall out of her head, being bloody and sore. Though these were some of the most miserable objects that could possibly be seen, yet they seemed to be quite unconcerned about their misfortunes, and traded as briskly as any of the rest.

MIDDLEHAM, a town in the north riding of Yorkshire, situated on the river Ure, 255 miles from London. It had once a castle, where was born Edward prince of Wales, only son of Richard III; and is noted for a woollen manufactory and frequent horse-races. Its market is on Monday; and fairs Nov. 6. and 7. The town stands on a rising ground; and the castle was formerly moated round by the help of a spring conveyed in pipes from the higher grounds. The population in 1811 was 714.

Middleham || Middleton.

MIDDLESEX, a county of England, which derives its name from its situation amidst the three kingdoms of the East, West, and South Saxons. It is bounded on the north by Hertfordshire; on the south by the river Thames, which divides it from Surry; on the west by the river Colne, which separates it from Buckinghamshire; and on the east by the river Lea, which divides it from Essex. It extends about 23 miles in length, but hardly 14 in breadth, and is not more than 115 in circumference; but as it comprehends the two vast cities of London and Westminster, which are situated in the south-east part of the county, it is by far the wealthiest and most populous county in England. It is divided into 602 liberties, containing 200 parishes, besides a vast number of chapels of ease, and 5 market towns, exclusive of the cities of London and Westminster. The air is very pleasant and healthy. The soil, which is gravelly, produces plenty of corn, and the county abounds with fertile meadows and gardeners grounds. In a word, the greater part of the county is so prodigiously assisted by the rich compost from London, that the whole of the cultivated part may be considered as a garden. The natural productions are cattle, corn, and fruit; but its manufactures are too many to be enumerated here, there being hardly a single manufacture practised in Great Britain but what is also established in this county.—Though London is the chief city, Brentford is the county town where the members of parliament are elected. In 1811 it contained 126,269 houses, and 904,358 inhabitants in towns, and 8670 houses, and 48,918 inhabitants in the country, making altogether 953,276 inhabitants. See MIDDLESEX, SUPPLEMENT.

MIDDLESEX is also the name of four different counties in the United States of America; one of them is in Massachussets, another in Connecticut, a third in New Jersey, and the fourth in Virginia.

MIDDLETON, DR CONYERS, a very celebrated English divine, the son of a clergyman in Yorkshire, was born at Richmond in 1683. He distinguished himself, while fellow of Trinity college, Cambridge, by his controversy with Dr Bentley his master, relating to some mercenary conduct of the latter in that station. He afterwards had a controversy with the whole body of physicians on the dignity of the medical profession; concerning which he published *De medicorum apud veteres Romanos degentium conditione dissertatio; qua, contra viros celeberrimos Jacobum Sponium et Richardum Meadium, servilem atque ignobilem eam fuisse ostenditur:* and in the course of this dispute much resentment and many pamphlets appeared. Hitherto he had stood well with his clerical brethren; but he drew the resentment of the church on him in 1729, by writing "A Letter from Rome, showing an exact conformity between Popery and Paganism," &c.; as this letter, though politely written, yet attacked Popish miracles with a gaiety that appeared dangerous to the cause of miracles in general. Nor were his Objections to Dr Waterland's manner of vindicating Scripture against Tindal's "Christianity as old as the Creation," looked on in a more favourable point of view. In 1741, came out his great work, "The history of the life of M. Tullius Cicero,"

Middleton || Midship-frame.

Cicero," 2 vols 4to: which is indeed a fine performance, and will probably be read as long as taste and polite literature subsist among us: the author has nevertheless fallen into the common error of biographers, who often give panegyrics instead of history. In 1748, he published, "A free inquiry into the miraculous powers which are supposed to have subsisted in the Christian church from the earliest ages, through several successive centuries." He was now attacked from all quarters; but before he took any notice of his antagonists, he supplied them with another subject, in "An examination of the Lord Bishop of London's discourses concerning the use and extent of prophecy," &c. Thus Dr Middleton continued to display talents and learning, which are highly esteemed by men of a free turn of mind, but by no means in a method calculated to invite promotion in the clerical line. He was in 1723 chosen principal librarian of the public library at Cambridge; and if he rose not to dignities in the church, he was in easy circumstances, which permitted him to assert a dignity of mind often forgotten in the career of preferment. He died in 1750, at Hildersham in Cambridgeshire, an estate of his own purchasing; and in 1752, all his works, except the life of Cicero, were collected in 4 vols 4to.

MIDDLEWICH, a town of Cheshire, 167 miles from London. It stands near the conflux of the Croke and Dan, where are two salt water springs, from which are made great quantities of salt, the brine being said to be so strong as to produce a full fourth part salt. It is an ancient borough, governed by burgesses; and its parish extends into many adjacent townships. It has a spacious church. By means of inland navigation, it has communication with the rivers Mersey, Dee, Ribble, Ouse, Trent, Darwent, Severn, Humber, Thames, Avon, &c.; which navigation, including its windings, extends above 500 miles, in the counties of Lincoln, Nottingham, York, Lancaster, Westmoreland, Stafford, Warwick, Leicester, Oxford, Worcester, &c. The river Wheelock, after a course of about 12 miles from Mowcop-hill, runs into the Dan a little above this town. Its population in 1811 was 1232.

MIDHURST, a town of Sussex, 52 miles from London, has been represented in parliament ever since the 4th of Edward II. It is a neat small town, on a hill surrounded with others, having the river Arun at the bottom; and is a borough by prescription, governed by a bailiff, chosen annually by a jury at a court-leet of the lord of the manor.

MIDIAN, or MADIAN, in *Ancient Geography*, a town on the south side of Arabia Petræa, so called from one of the sons of Abraham by Keturah.—Another *Midian*, near the Arnon and Æoplis, in ruins in Jerome's time. With the daughters of these Midianites the Israelites committed fornication, and were guilty of idolatry. A branch of the Midianites dwelt on the Arabian gulf, and were called *Kenites:* some of whom turned proselytes, and dwelt with the Israelites in the land of Canaan.

MID-LOTHIAN. See LOTHIAN and EDINBURGHSHIRE.

MIDSHIP-FRAME, a name given to that timber, or combination of pieces formed into one timber, which determines the extreme breadth of the ship, as well as the figure and dimension of all the inferior timbers. Midship-frame || Midship-man.

In the article *Ship-Building*, the reader will find a full explanation of what is meant by a frame of timbers. He will also perceive the outlines of all the principal frames, with their gradual dimensions, from the midship-frame, delineated in the plane of projection annexed to that article.

MIDSHIPMAN, a sort of naval cadet, appointed by the captain of a ship of war, to second the orders of the superior officers, and assist in the necessary business of the vessel, either aboard or ashore.

The number of midshipmen, like that of several other officers, is always in proportion to the size of the ship to which they belong. Thus a first-rate man of war has 24, and the inferior rates a suitable number in proportion. No person can be appointed lieutenant without having previously served two years in the royal navy in this capacity, or in that of *mate*, besides having been at least four years in actual service at sea, either in merchant ships or in the royal navy.

Midshipman is accordingly the station in which a young volunteer is trained in the several exercises necessary to attain a sufficient knowledge of the machinery, movements, and military operations of a ship, to qualify him for a sea officer.

On his first entrance in a ship of war, every midshipman has several disadvantageous circumstances to encounter. These are partly occasioned by the nature of the sea service; and partly by the mistaken prejudices of people in general respecting naval discipline, and the genius of sailors and their officers. No character, in their opinion, is more excellent than that of the common sailor, whom they generally suppose to be treated with great severity by his officers, drawing a comparison between them not very advantageous to the latter. The midshipman usually comes aboard tinctured with these prejudices, especially if his education has been amongst the higher rank of people; and if the officers happen to answer his opinion, he conceives an early disgust to the service, from a very partial and incompetent view of its operations. Blinded by these prepossessions, he is thrown off his guard, and very soon surprised to find, amongst those honest sailors, a crew of abandoned miscreants, ripe for any mischief or villany. Perhaps, after a little observation, many of them will appear to him equally destitute of gratitude, shame, or justice, and only deterred from the commission of any crimes by the terror of severe punishment. He will discover, that the pernicious example of a few of the vilest in a ship of war is too often apt to poison the principles of the greatest number, especially if the reins of discipline are too much relaxed, so as to foster that idleness and dissipation, which engender sloth, diseases, and an utter profligacy of manners. If the midshipman on many occasions is obliged to mix with these, particularly in the exercises of extending or reducing the sails in the tops, he ought resolutely to guard against this contagion, with which the morals of his inferiors may be infected. He should, however, avail himself of their knowledge, and acquire their expertness in managing and fixing the sails and rigging, and never suffer himself to be excelled by an inferior. He will probably find a virtue in almost

Midshipman.

every private sailor, which is entirely unknown to many of his officers: that virtue is emulation, which is not indeed mentioned amongst their qualities by the gentlemen of *terra firma*, by whom their characters are often copiously described with very little judgment. There is hardly a common tar who is not envious of superior skill in his fellows, and jealous on all occasions to be outdone in what he considers as a branch of his duty: nor is he more afraid of the dreadful consequences of whistling in a storm, than of being stigmatized with the opprobrious epithet of *lubber*. Fortified against this scandal, by a thorough knowledge of his business, the sailor will sometimes sneer in private at the execution of orders which to him appear awkward, improper, or unlike a seaman. Nay, he will perhaps be malicious enough to suppress his own judgment, and, by a punctual obedience to command, execute whatever is to be performed in a manner which he knows to be improper, in order to expose the person commanding to disgrace and ridicule. Little skilled in the method of the schools, he considers the officer who cons his lesson by rote as very ill qualified for his station, because particular situations might render it necessary for the said officer to assist at putting his own orders in practice. An ignorance in this practical knowledge will therefore necessarily be thought an unpardonable deficiency by those who are to follow his directions. Hence the midshipman who associates with these sailors in the tops, till he has acquired a competent skill in the service of extending or reducing the sails, &c. will be often entertained with a number of scurrilous jests, at the expence of his superiors. Hence also he will learn, that a timely application to those exercises can only prevent him from appearing in the same despicable point of view, which must certainly be a cruel mortification to a man of the smallest sensibility.

If the midshipman is not employed in these services, which are undoubtedly necessary to give him a clearer idea of the different parts of his occupation, a variety of other objects present themselves to his attention. Without presuming to dictate the studies which are most essential to his improvement, we could wish to recommend such as are most suitable to the bent of his inclination. Astronomy, geometry, and mechanics, which are in the first rank of science, are the materials which form the skilful pilot and the superior mariner. The theory of navigation is entirely derived from the two former, and all the machinery and movements of a ship are founded upon the latter. The action of the wind upon the sails, and the resistance of the water at the stem, naturally dictate an inquiry into the property of solids and fluids; and the state of the ship, floating on the water, seems to direct his application to the study of hydrostatics, and the effects of gravity. A proficiency in these branches of science will equally enlarge his views, with regard to the operations of naval war, as directed by the efforts of powder and the knowledge of projectiles. The most effectual method to excite his application to those studies, is, perhaps, by looking round the navy, to observe the characters of individuals. By this inquiry he will probably discover, that the officer who is eminently skilled in the sciences, will command universal respect and approbation; and that whoever is satisfied with the despicable ambition of shining the hero of an assembly, will be the object of universal contempt. The attention of the former will be engaged in those studies which are highly useful to himself in particular, and to the service in general. The employment of the latter is to acquire those superficial accomplishments that unbend the mind from every useful science, emasculate the judgment, and render the hero infinitely more dexterous at falling into his station in the dance than in the line of battle.

Midshipman, Midwife.

Unless the midshipman has an unconquerable aversion to the acquisition of those qualifications which are so essential to his improvement, he will very rarely want opportunities of making a progress therein. Every step he advances in those meritorious employments will facilitate his accession to the next in order. If the dunces, who are his officers or messmates, are rattling the dice, roaring bad verses, hissing on the flute, or scraping discord from the fiddle, his attention to more noble studies will sweeten the hours of relaxation. He should recollect, that no example from fools ought to influence his conduct, or seduce him from that laudable ambition which his honour and advantage are equally concerned to pursue.

MIDWIFE, one whose profession is to deliver women in labour. See MIDWIFERY.

MIDWIFERY,

1 Definition.

THE art of assisting women in labour. In a more extended sense, it is understood to comprehend also the treatment of the diseases of women and children. In this work we shall consider it in the former limited sense, viz. as relating to the birth of the offspring of man.

2 *History of Midwifery.*—It must be very obvious that this art must have been almost coeval with mankind: but in Europe it continued in a very rude state till the 17th century; and even after physic and surgery had become distinct professions, it remained almost totally uncultivated.

3 It is a curious fact, that in the empire of China the very reverse of this has taken place. In that empire, according to the latest accounts, both physic and surgery are still in a state of the utmost degradation, even more so than among the savages of America; but for some hundred years, the art of midwifery has been practised by a set of men destined to the purpose by order of government. These men, who hold in society the same rank which lithotomists did in this country about the beginning of last century, are called in whenever a woman has been above a certain number of hours in labour, and employ a mechanical contrivance for

History. for completing the delivery without injury to the infant. A certain number of such individuals is allotted to each district of a certain population.

It is said, that the Chinese government was led to make this provision for alleviating the sufferings of child-bearing women, in consequence of a representation, that annually many women died undelivered, and that in the majority of cases the cause of obstruction might have been removed by very simple mechanical expedients.

Both Sir George Staunton and Mr Barrow were ignorant of this fact; and the latter in particular expressly mentions, that there are no men-midwives in China. But the writer of this article had his information from a more authentic source than the works of gentlemen who were only a few months in that country, and were in a great measure treated as state prisoners. He has it, through the medium of a friend, from a gentleman who resided upwards of twenty years as surgeon to the British factory at Canton, and who had both the ability and the inclination to learn, during the course of so long a residence, all the customs and prejudices of the natives relating to the preservation of human health.

4 Towards the end of the 17th century, the same causes which had so long before led to the cultivation of midwifery in China produced the same effect in Europe. The dangers to which women are sometimes exposed during labour excited the compassion of the benevolent; so that a considerable part of the first hospital which was established for the reception of the indigent sick, the Hotel Dieu of Paris was appropriated to lying-in women.

The opportunities of practice which that hospital afforded, directed the attention of medical men to the numerous accidents which happen during labour, and to the various diseases which occur after delivery. Public teaching followed, and soon after the custom of employing men in the practice of midwifery began.

From this period the art became rapidly improved; and it is now in many parts of Europe, and particularly in Great Britain, in as great a state of perfection as physic or surgery.

5 In the year 1725, a professorship of midwifery was established in the university of Edinburgh; and the town-council at the same time ordained, that no woman should be allowed to practise midwifery within the liberties of the city, without having previously obtained a certificate from the professor of her being properly qualified. This salutary regulation has fallen into desuetude.

There can be no doubt that the improvement of the art of midwifery was chiefly in consequence of medical men directing their attention to the subject; but the propriety of men being employed in such a profession is much questioned by many individuals of considerable respectability.

6 Dr John Gregory, in his Comparative View, p. 22. says, "every other animal brings forth its young without any assistance, but we think a midwife understands it better." Had this eminent philosopher said, "other animals content themselves with the clothing which providence has bestowed, but we think it necessary to cover our bodies with the workmanship of weavers," very few in this northern climate would have attended to the sneer. His son, the present professor, has improved upon the idea. He seems to suppose that women without any instruction, and of course without any knowledge of the subject, are capable of assisting one another while in labour; and in the sportiveness of his lively imagination, he compares men-midwives to that species of frog, in which, according to the allegation of Reaumur, the male draws out the ova from the female, or, to use the naturalist's words, "*accouche la femelle.*" Of Conception

It appears to us that this question, on which much declamation has been employed by the parties who have agitated it, may be brought within a very narrow compass. It may be assumed as a fact established beyond the reach of controversy, that sometimes dangers and difficulties occur during labour (from causes to be explained in a subsequent part of this essay), which can be lessened or removed by those only who have an intimate knowledge of the structure of the human body and of the practice of physic. On such occasions, it must be admitted, medical men alone can be useful. But as such labours occur only in the proportion of two or three in the hundred, the general practice might be confided to midwives, if they could be taught to manage ordinary cases, and to foresee and distinguish difficulties or dangers, so as to procure in sufficient time additional assistance. It is on this point that the decision of the question must depend. It consists with the knowledge of the writer of this article, that women may be taught all this. But there are many who allege, that a little knowledge being a dangerous thing, midwives acquire a self-sufficiency which renders them averse from calling in superior assistance, and that, in consequence, they often occasion the most deplorable accidents both to mother and child. In England this is the popular opinion, so that there women are almost entirely excluded from the practice of midwifery. A similar prejudice against midwives has, it is believed, begun in some parts of Scotland; but it is presumed this will gradually cease, when it is considered that, in general, the Scotch midwives are regularly instructed, and are at the same time both virtuous and industrious. If they attend strictly to their duty, and invariably prefer their patients safety to their own feelings or supposed interest, they will deservedly retain the public confidence. But if in cases of difficulty or danger they trust to their own exertions, or from disinterested motives decline the assistance of able practitioners, and if they interfere in the treatment of the diseases of women and children, they will in a few years be excluded from practice.

Division of the subject. In order to exhibit an accurate view of what relates to the birth of man, we shall consider, in the first place, conception; secondly, the effects of impregnation; thirdly, the act of childbearing; and lastly, the deviations from the ordinary course which sometimes happen. These topics will form the subjects of the following chapters. 7

Chap. I. *Of Conception.*

Three circumstances are required for conception in the human race, viz. puberty; a healthy, vigorous, and natural state of the parts subservient to the operation in both sexes; and successful sexual intercourse. 9

1. The age of puberty in women differs considerably

Of Conception.

in different climates. In Europe it takes place commonly between the fourteenth and sixteenth year. This important era is marked by certain changes both in the mind and body. The girl feels sensations to which she had been formerly unaccustomed. She loses a relish for her former amusements, and even for her youthful companions. She seeks solitude, indulges in the depressing passions, and these are excited by the most apparently trifling causes. She feels occasionally certain desires which modesty represses; and it is by degrees only that she regains her former tranquillity.

The changes in her body are even more strongly marked than those in her mind. Her breasts assume that form which adds to the beauty of her person, and renders them fit for nourishing her infant; and every part of the genital system is enlarged. A periodical discharge from the uterus renders the woman perfect.

9 In young men the same causes produce very different effects. The lad, about fifteen or sixteen, feels a great increase of strength; his features expand, his voice becomes rough, his step firm, his body athletic; and he engages voluntarily in exercises which require an exertion of strength and activity. The changes in his mind are as strongly marked as those in his body. He loses that restless puerility which had distinguished his early years, and becomes capable of attending steadily to one object. His behaviour to the fair sex is suddenly altered. He no longer shows that contempt for women, which he had formerly betrayed. He is softened, approaches them with deference, and experiences a degree of pleasure in their company, for which he can scarcely account. In him too there is an important change in the condition of the genital organs.

10 2. Unless the parts which constitute peculiarity of sex be in a healthy, vigorous, and natural state, conception cannot take place.

In women, conception is prevented if the organs be too much relaxed; if there be obstruction between the external and internal parts; if any preternatural discharge take place from the internal parts; if the menstrual evacuation be not natural in every respect, and if the appendages of the uterus, called fallopian tubes, and ovaria, be not of the natural structure.

In men, the same circumstance happens if the organs be too much relaxed; if the orifice of the urethra be in an improper situation; if the urethra be diseased; if the testes be not in a natural healthy state; and if there be any defect in the erectores penis, which prevents the proper erection of that organ.

11 3. The sexual intercourse cannot be successful unless somewhat necessary for conception be furnished by both sexes. This consists in the male of a fluid secreted by the testes; and in the female, of a detachment of a substance, supposed to resemble a very minute vesicle situated in the ovarium, and called by physiologists ovum. Each ovarium contains a number of these vesicles. After every conception, certain marks of the detachment of the ovum remain in the respective ovarium.

When the circumstances required for conception concur, a being is produced which generally resembles both parents. This resemblance is most strikingly marked in the human subject, when one of the parents is an European, and the other an African. What is called a mulatto is produced.

Of Conception.

12 The human race possesses the power of propagation in common with all the other species of the animal kingdom, and also, it has been said, with the vegetable kingdom.

As generation then, as it has been styled, is common to two of the kingdoms of nature, it has been imagined by ingenious men, that this wonderful operation is regulated in both by a certain general law. But they have differed much in their account of this law. The question at issue between the two parties is whether the embryos of animals be prepared by the sexual intercourse out of inorganic materials, or whether they pre-exist in the bodies of animals, and are only developed as it were by that intercourse. The former of these opinions is called the doctrine of epigenesis, the latter that of evolution.

Both doctrines have been maintained with much ingenuity by equally respectable authorities. Negative arguments have been adduced in favour of the one, positive in support of the other, and it must be confessed that the balance between them seems nearly equal. The pre-existence of ova in the oviparous animals appears a positive argument in favour of evolution; but the satirical remark of a late witty author,* that, were this theory true, every individual of the human race must have been lodged in the ovaria of our first parent, by affording a negative argument in favour of epigenesis, restores the balance.

* *Blumenbach.*

The various arguments advanced on each side by the opposite parties in this dispute are so very numerous, that we cannot attempt to detail them in this work; and on a subject which has divided the opinions of so many able physiologists, it would be presumption to decide peremptorily.

If generation be regarded as an animal operation, one is led to inquire whether the product be the result of the combined influence of both sexes, or whether it be produced by either sex alone.

13 The first opinion was generally adopted by physiologists, till about the end of the 17th century, when an accidental discovery convinced many that the embryo was produced by the male parent alone; and another discovery some years afterwards again overturned that opinion, and rendered it believed by not a few that the embryo is furnished exclusively by the female parent.

Several circumstances concurred to render the first opinion probable; the structure of the organs which constitute peculiarity of sex in both parents, the circumstances necessary for successful impregnation, and the similitude of children to both parents, appear very strong arguments in its favour.

14 The second theory, although first brought into vogue about the end of the 17th century by the discoveries of Leeuwenhoeck, had been formerly proposed by the followers of Pythagoras. Their argument was analogy: the seed, said they, is sown in the earth, nourished and evolved there; so the male semen is sown in the uterus, and in the same manner nourished and evolved.

Leeuwenhoeck's discovery seemed a more conclusive argument in favour of the theory than vague analogy.

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He observed innumerable animalcula in the seminal fluid of the males of many animals. These he imagined to be embryos.

But as animalcula of apparently the same nature have been observed in many animal fluids besides the semen masculinum, the opinion of Leeuwenhoeck and the theory itself are overturned.

15 It was owing principally to the labours, industry, and ingenuity of Baron Haller, that the third theory, that of the pre-existing germ, became fashionable.

His observations seem to contain a demonstration of the fact.

Those who have adopted this theory, imagine that the semen masculinum possesses the power of stimulating the various parts of the pre-existing embryo. And hence they attribute the similitude to both parents, and particularly the appearance of the hybrid productions, to that fluid nourishing certain parts, and new-arranging others. But if this were true, then the semen masculinum of all animals should possess the power of stimulating the germs of all female animals; and besides, in each class of animals it should possess certain specific powers of giving a direction to the growth of parts. Experience, however, has not proved this to be the case, for the hybrid productions are very limited; and we may be permitted perhaps, without the imputation of arrogance in pretending to search into the intentions of the Author of nature, to observe, that had the semen masculinum been possessed of such powers, the whole species of animals would have been soon confounded, and the whole animal kingdom would soon have returned to that chaos from which it has been allegorically said it originated.

Yet we are reduced to the alternative of either rejecting the theory, or of believing that the semen does possess the powers alluded to. If we examine attentively the anatomical discovery on which this theory is built, we shall perhaps be inclined to believe that the foundation of the whole is very insufficient; and hence to conclude that the great superstructure is in a very tottering condition. If it be possible that the attachment of the chick to the yolk of the egg should be in consequence of inosculation, the theory must fall to the ground. Haller has endeavoured to obviate this objection, but not with his usual judgment.

16 Two circumstances, however, seem to show that the attachment is really by inosculation: 1. That vessels are seen in the membrane of the yolk evidently containing blood before the heart of the chick begins to beat; yet these vessels afterwards appear to depend on the vascular system of the chick. And, 2. That in many animals, as in the human subject, the umbilical cord seems to be attached to the abdomen by inosculation; for there is a circle round the root of the cord which resembles a cicatrix, and within a few days after birth, the cord uniformly drops off at that very circle, whatever portion may have been retained after delivery.

17 There is one objection equally applicable to all the three theories, viz. the difficulty of explaining the steps of the process. A variety of explanations have been offered by ingenious men. Spallanzani and Mr John Hunter lately, Haller and Bonnet formerly, have rendered themselves conspicuous on this subject. Spallanzani, in particular, appears to many to have produced, by his artificial impregnation, the most convincing proofs of the pre-existence of the germ. But to what do his celebrated experiments amount? They show, that in all animals it is necessary that the semen masculinum should be applied to the somewhat expelled by the female during the coitus, otherwise impregnation cannot take place. But was not this universally acknowledged before the abbé was born? In the unfortunate frogs who were the subjects of his experiments, the whole operation of generation was completed except the application of the male semen to the substances expelled by the female. Nature, by establishing that the business should be carried on in water, shows that the semen must be diluted, otherwise it cannot fecundate. The abbé only imitated nature. He left the question in the state in which he found it. His experiment on the bitch may appear more conclusive; but alas! it has never succeeded with any person but himself.

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On the whole, since the process of generation is so obscure that no rational explanation of it has yet been offered, are we not entitled to conclude that the general theory which accounts most satisfactorily for the various phenomena which impregnation exhibits is the best; and consequently, that the product of generation cannot pre-exist in the body of either parent exclusively?

Chap. II. *Effects of Impregnation.*

18

In consequence of impregnation, certain important changes take place in the uterine system of the human subject. We shall consider the natural changes only. On some occasions, there are morbid changes; but we shall not notice them, except in so far as some of them serve to illustrate the nature of the usual ones.

The first visible change is on the ovarium. One of those organs swells out at one point like a small papilla, then bursts, and somewhat is discharged.

19 A substance is found in the ovarium after this, which is called *corpus luteum*. Rœderer has described very accurately its appearance a few hours after delivery. He says "corpus luteum locatur in rotundo apice. Totam ovarii crassitiem occupat, immediatè pone ovarii membranam illa sede tenuiorem locatum; ab ovario cum quo cellulosæ ope cohæret separari sine lesione potest; nulli peculiari ovarii rimæ respondet: neque canalis in illo excavatus, sed totum solidum est. Luteus color est, substantia acinosa, acinis admodum compactis et ad sese pressis ambitus rotundus. Potest aliquo modo, velut in glandulis suprarenalibus, duplex substantia distingui, corticalis et medullaris; quarum illa inæqualis crassitiei 1—2 lin. lutea comprehendit hanc medullarem albam, quæ tenuis et membrana quasi callosa, alium nucleum flavum includit cassiorem *." It is very large soon after conception, and then gradually becomes smaller; but never totally disappears. Rœderer observes, "post puerperium eo magis contrahi et indurari illa corpora videntur, quo remotior sit partus; qualia videlicet observantur in feminis quæ nuper partum non ediderunt.

" Lutea corpora quo serius à partu observantur cuncta glandulis suprarenalibus similia esse videntur, duplice nempe substantia, exteriore corticali, solida seu flava lutea et nucleo fusco: velut etiam illæ glandulæ compressa sunt †." In cases where there is a plurality of children,

* *Roederer Icones Uteri Humani illustrantes. Gottingæ 1759. fol. p. 43.*

† *Ibid. p.*

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children, there is evidently a corpus luteum to each child. In some quadrupeds, as in the bitch or cat, the number of young in the uterus may be generally known by the corresponding corpora lutea in the ovaria.

20 The next change in the human uterine system which deserves notice is that in the fallopian tubes. They swell out towards the fimbriated extremity, and form a cavity which has been called antrum. Rœderer was the first who observed and accurately delineated this change.

He says, p. 14. loco citato, "In hoc etiam utero antrum tubæ dextræ apparet, *c. f.* tab. i. not. 5. ubi quidem in utraque tuba adest, in hujus iconis utero ad solam tubam dextram antrum pertinet. Ad uterum feminæ octiduum puerperæ non longe a fimbria in istiusmodi antrum tuba sinistra prominet: dextra quidem sine antro est, sed versus fimbriam ita flectitur ut ultima flexura dimidium pollicem ultra reliquam tubam efferatur. Tubæ feminæ quæ mox a maturo partu mortua est, et alterius tres dies puerperæ antris quidem carent, sed multum versus fimbrias dilatantur. An est facta conceptione ista antra nascuntur?

"In uteri, tab. iv. ovario dextro luteum corpus latet in uteri feminæ octiduum puerperæ ovario sinistro; in uteri, tab. i. ovario sinistro." He adds, "ulteriori indagine ista antra non indigna esse mihi videntur. Licebit forsan conjectare aliquid liquoris ex vesicula graafiana in tubam lapsum et ad introitum morans illam dilatam."

21 But the most astonishing changes are those produced in the uterus itself. Its parietes separate, a cavity is formed which becomes filled with a fluid, and the os uteri is closed up. The matter contained within the cavity soon assumes an organized form. It is said that some time after conception, a small vesicle is observed attached at one point to the internal surface of the uterus; that the rest of the parietes is covered with a gelatinous fluid; and that the whole internal surface assumes a flocculent appearance. By degrees the vesicle, which is in fact the ovum containing the embryo, increases so much in size that it nearly fills the whole cavity in which it is contained, and then its structure becomes the object of our senses.

22 The increase of size in the uterus is very gradual. It is at first confined almost entirely to the fundus, and it proceeds so slowly that it does not leave the cavity of the pelvis till nearly the fourth month. The principal change in the cervix for the first five months is the complete closure of the orifice, which is effected by a gelatinous fluid: afterwards the cervix is gradually extended, and at last its form is obliterated, the whole uterus becoming like an oval pouch.

After the fifth month the increase of size in the uterus is very rapid. The fundus can be just felt above the pubes about the fifth month, but at the end of the ninth month it extends to the scrobiculus cordis.

Some authors have alleged that the changes in the cervix and in the situation of the fundus are so uniformly regular in every case, that by attending to them it is possible to ascertain the exact period of impregnation. But in this respect they are much mistaken; the changes being not only different in different women, but also in the same woman in different pregnancies.

The texture of the parietes of the uterus seems much altered after impregnation. It becomes spongy and fibrous. The fibres run in very different directions, and from their power and appearance are certainly muscular. The blood-vessels become much enlarged, but are still in a tortuous direction. They are particularly large at one part of the uterus. Effects of Impregnation.

The lymphatic vessels, which in the unimpregnated uterus cannot be demonstrated by anatomists, become, as well as the blood-vessels, remarkably large.

The ovum is not often expelled entire till after the eighth or twelfth week after conception. It is shaped somewhat like an egg, and is about the latter period about four inches in length. When cut into, it is found to consist of four layers or membranes, and to contain a fœtus surrounded by a certain quantity of water, and connected to one part of the parietes (which is considerably thicker than the rest) by a vascular cord. 23

The external membrane covers the whole ovum. It is thick, spongy, and very vascular, the vessels evidently deriving their blood from the uterus; it has three perforations which correspond with the openings of the os tincæ and fallopian tubes. It has been called *decidua*, *tunica filamentosa*, &c. but its most ordinary appellation is spongy chorion. 24

The second membrane proceeds from the edges of that part into which the vascular rope which connects the fœtus is attached. It was first pointed out to anatomists by Dr William Hunter, and called by him *decidua reflexa*. The name unfortunately records to posterity the absurd idea respecting its origin which was entertained by Dr Hunter. It is not so thick and spongy as the former membrane, nor so vascular. It lies loosely between the external membrane and that to be next described; but it appears only for a short time, as it soon becomes blended with the others. 25

The third membrane is thin and transparent, but strong. It is lined with the fourth membrane, and lies in the same situation with it. It contains no vessels at this period of impregnation conveying red blood in the human subject, but in the cow the vessels are very distinct at every period. This membrane however in the early period of impregnation is very vascular, and its vessels are derived from the fœtus. The history of a case of morbid impregnation, where the fœtus was extra-uterine, detailed by Dr Clarke in the "Transactions of a Society for the Improvement of Medical and Chirurgical Knowledge," proves this circumstance very clearly. He says, p. 220. "a laceration was found to be in the fallopian tube about an inch and a half in length, each extremity of which was about an equal distance from the respective termination of the tube in the fimbriæ and in the uterus. The distension of the tube at this part was nearly of the size of a large walnut, forming a kind of pouch. More of the coagulated blood being removed from the lacerated part, the *shaggy vessels of the chorion* immediately appeared, interspersed with small coagula, and lying in contact with the internal surface of the pouch formed by the fallopian tube; these being separated, and the chorion divided, the amnios shewed itself, containing a fœtus perfectly formed of above six or seven weeks growth," &c. 26

This membrane is called the true chorion.

The fourth membrane is even thinner and more transparent 27

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parent than the former. It lines the whole internal surface of the ovum, and together with the chorion is continued along the vascular cord which connects the ovum and fœtus. Between this membrane and the chorion, near the insertion of the vascular cord, a small white vesicle appears very distinct at this period; it was first described and delineated by Dr W. Hunter, and was called by him vesicula umbilicalis. At the full period of utero-gestation it is no longer visible, being then quite transparent.

The fœtus at this period is between two and three inches in length, and its external conformation is nearly complete.

The fluid contained in the ovum is in such quantity as to prevent the fœtus from touching the parietes of the covering in which it is included. It is a clear watery fluid, of greater specific gravity than water, and of a saltish taste. When examined chemically it is found not coagulable by heat or alcohol, and to contain a proportion of ammoniacal and sea salt. This fluid is called liquor amnii.

The connection of the parts thus enumerated with the uterus cannot be explained, unless the appearance of the ovum at the full period of gestation be described.

28 The ovum then consists of three membranes; a spongy vascular substance called placenta, to which the fœtus is connected by a vascular rope, and the liquor amnii.

The three membranes consist of the spongy chorion, the true chorion, and the amnios.

The spongy chorion covers the whole. Its vessels are numerous, and they can be filled by throwing hot wax into the vessels of the uterus.

The true chorion and amnios are in the same situation as in the early months, being continued along the navel-string. They are quite transparent, and contain no visible vessels of any description.

The placenta is a large vascular spongy mass, of various forms in different cases, most generally approaching to a round one, placed on the outside of the true chorion, between it and the spongy chorion. Its external surface is lobulated; its internal or that towards the fœtus is smooth, except from the rising of the blood-vessels.

It is not attached to the uterus at any regular place, being sometimes at the cervix or side, but most generally about the fundus. On the one side it receives blood from the mother, and on the other from the child. Mr John Hunter was the first who clearly traced the insertion of the blood vessels in the uterus into the placenta. He describes it thus (D): "The late indefatigable Dr M'Kenzie, about the month of May 1754, when assistant to Dr Smellie, having procured the body of a pregnant woman who had died undelivered at the full term, had injected both the veins and arteries with particular success; the veins being filled with yellow, the arteries with red.

"Having opened the abdomen, and exposed the uterus, he made an incision into the fore part, quite through its substance, and came to somewhat having the appearance of an irregular mass of injected matter, which afterwards proved to be the placenta. This appearance being new, he stopped, and greatly obliged me by desiring my attendance to examine the parts, in which there appeared something so uncommon.

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"I first raised, with great care, part of the uterus from the irregular mass above mentioned; in doing which, I observed regular pieces of wax, passing obliquely between it and the uterus, which broke off, leaving part upon this mass; and when they were attentively examined, towards the uterus, plainly appeared to be a continuation of the veins passing from it to this substance or placenta.

"I likewise perceived other vessels, about the size of a crow quill, passing in the same manner, although not so obliquely: these also broke upon separating the placenta and uterus, leaving a small portion on the surface of the placenta; and, on examination, they were discovered to be continuations of the arteries of the uterus. My next step was to trace these vessels into the substance of what appeared placenta, which I first attempted in a vein; but that soon lost the regularity of a vessel, by terminating at once upon the surface of the placenta, in a very fine spongy substance, the interstices of which were filled with the yellow injected matter. This termination being new, I repeated the same kind of examination on other veins, which always led me to the same terminations, never entering the substance of the placenta in the form of a vessel. I next examined the arteries, and, tracing them in the same manner toward the placenta, found that they made a twist, or close spiral turn upon themselves, and then were lost on its surface. On a more attentive view, I perceived that they terminated in the same way as the veins; for opposite to the mouth of the artery, the spongy substance of the placenta was readily observed, and was intermixed with the red injection.

"Upon cutting into the placenta, I discovered, in many places of its substance, yellow injection; in others red, and in many others these two colours mixed. This substance of the placenta, now filled with injection, had nothing of the vascular appearance, nor that of extravasation, but had a regularity in its form, which shewed it to be a natural cellular structure fitted for a reservoir for blood.

"In some of the vessels leading from the placenta to the uterus, I perceived that the red injection of the arteries (which had been first injected) had passed into them out of the substance of the placenta, mixing itself with the yellow injection. I also observed, that the spongy chorion, called the decidua by Dr Hunter, was very vascular, its vessels coming from, and returning to, the uterus, being filled with the different coloured injections."

It appears then that the placenta has a cellular structure, which receives blood from the arteries of the mother, and that there are veins by which that blood is returned, so that not a drop passes into the fœtus. Of this practitioners of midwifery have a very familiar proof. When the placenta is retained attached to the uterus, after the birth of the child, not a drop of blood passes from the umbilical cord, except what was contained in the ramifications of the fœtal vessels when the child

(D) Observations on certain parts of the Animal Oeconomy, by John Hunter, p. 127.

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child was separated. Yet, if a small portion of the edge of the placenta be detached, such a quantity of blood escapes from the uterine vessels of the mother, as sometimes proves fatal to life: a circumstance which clearly shews that the blood is still conveyed into the cellular part of the placenta.

It has been said, that the placenta on one side receives blood from the fœtus. In fact, the greatest part of the placenta seems to be made up of ramifications of the fœtal vessels. The internal iliacs of the fœtus are conveyed, through the vascular rope which connects the placenta and child, into the placenta: they then ramify into as many minute branches as the pulmonary arteries do in the lungs of the adult; they then terminate in various branches, which, uniting, form one large trunk that is conveyed along the vascular rope, and returns all the blood which had been distributed by the arteries.

As Mr Hunter remarks, "the arteries from the fœtus pass out to a considerable length, under the name of the umbilical cord; and when they arrive at the placenta, ramify upon its surface, sending into its substance branches which pass through it, and divide into smaller and smaller, till at last they terminate in veins: these uniting, become larger and larger, and end in one which at last terminates in the proper circulation of the fœtus. This course of vessels, and the blood's motion in them, is similar to the course of the vessels, and the motion of the blood, in other parts of the body*."

* *J. Hunter*, loc. cit. p. 135.

The fœtus, at the full period, weighs from between 6 and 7, to between 10 and 11 pounds, and measures from 18 to 22 inches. It is placed within the ovum in such a manner as to occupy the least possible space. This position has been beautifully described by Harvey. "Infans in utero utplurimum reperitur, adductis ad abdomen genibus, flexis retrorsum cruribus, pedibus decussatis, manibusque ad caput sublatis, quarum alteram circa tempora vel auriculas, alteram ad genam detinct, ubi maculæ albæ, tanquam confricationis vestigia, in cute cernuntur: spina in orbem flectitur, caput ad genua incurvato collo propendet. Tali membrorum situ qualem in sommo per quietem quærimus†."

30

† *Harvey Exercit. de Partu.*

The fœtus is distinguished from the adult by a great many peculiarities in structure: these the limits of this work do not permit us to enumerate. We shall therefore notice only one peculiarity, which distinguishes the fœtus not only from the adult, but even from the natus, viz. the distribution of the blood through its body.

31

It is well known, that, in the adult and in the natus, all the blood of the body, brought by the two cavæ into the anterior auricle of the heart, and from that into the corresponding ventricle, is distributed by the pulmonary artery over the whole substance of the lungs, by means of the most minute ramifications; from whence it is returned by the pulmonary veins into the posterior auricle, and being then sent into the posterior ventricle, is, by its action, transmitted to every part of the body, through the aorta and its ramifications.

But in the fœtus the blood follows another course. All the blood of the fœtus is returned from the placenta by the umbilical vein, which, penetrating the abdomen, passes between the lobes of the liver, and thence at right angles divides into two branches nearly, by one of which, called *ductus venosus*, a considerable quantity of blood is carried into the vena cava; by the other the remainder of the blood is sent to the vena portarum; and, after having circulated through the liver, it too is brought by two short venous trunks, the venæ cavæ hepaticæ, just above the diaphragm, into the vena cava. All the blood thus received into the vena cava, is carried to the anterior auricle; but a part only is transmitted to the corresponding ventricle, for by a particular apparatus, a quantity is at once sent into the posterior or left auricle. Anatomists have differed in opinion concerning the apparatus by which this is accomplished. As there is a small oval hole of communication between the auricles of the fœtus, called foramen ovale, having a valve placed in such a manner as to prevent any fluid from passing from the left into the right, but to admit it from the right into the left, it has been generally imagined that the blood passed through that opening. But the simultaneous action of the auricles in the natus seemed to contradict this opinion. A discovery made by Dr Wolfe of Petersburgh appears to solve the riddle. He observed, that in the calf, before birth, the vena cava, at its entry into the heart, divides into two branches, by the one of which it sends blood to the right, and by the other to the left auricle. It is probable that a similar effect is produced in the human fœtus by a different structure.

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Of the blood sent by the right ventricle into the pulmonary artery, a small quantity only is carried to the lungs; for near the point at which that artery is divided into the two branches that go into the lobes of the lungs, a large branch is sent off, which joining the aorta and pulmonary artery, carries a great proportion of the blood immediately into it. What is circulated through the lungs is conveyed by the pulmonary veins into the left auricle, &c.

All the blood thus received into the aorta is distributed through the several parts of the system, and a large part of it is sent out by the internal iliacs, which, passing out at the abdomen, constitute the umbilical arteries, and distribute the blood in the manner already mentioned over the placenta, from which it is returned by the veins.—The great difference then between the fœtus and natus in the circulation of the blood, consists in the quantity distributed through the lungs.

To complete the description of the ovum at the full period of gestation, it only remains that we should say something on the vascular rope, which connects the placenta and fœtus, and on the liquor amnii. 32

This rope is called the funis umbilicalis. It terminates by one end at the placenta, and by the other at the centre of the abdomen of the fœtus. Its length and thickness differ materially in different cases. It is longer in the human subject than in any other animal. It is found generally to be from eighteen to twenty-six inches in length, and in thickness about the size of the little finger. Externally it is formed of the chorion and amnios, together with cellular substance. Internally it is found to be composed of three blood-vessels, and a quantity of gelatinous matter. The vessels consist of two arteries and one vein: the vein being as large as both arteries united. These go in a spiral direction, and often form knots by their coils or twistings. A very small artery and vein are likewise perceived to

go

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go along the cord between the two layers of chorion and amnios, which cover it, into the vesicula umbilicalis. These are called omphalo-mesenteric.

33 In quadrupeds, a canal, called urachus, is continued from the urinary bladder, along the umbilical cord, and communicates with a membrane, which, like this canal, does not exist in the human subject, called allantois. The urine of the young animal is collected in that membrane.

Some anatomists, as Albinus, have imagined, that the urachus and allantois do exist in the human subject. They were deceived by the appearance of the vesicula umbilicalis and omphalo-mensenteric vessels.

The liquor amnii is never in such proportion to the fœtus in the latter, as in the early periods of pregnancy. It is less pure too at that period, being often polluted with the stools of the fœtus. Except in this circumstance, its chemical qualities are the same.

We shall now offer a few observations on the changes which have been described.

34 1. The cause of the increase of growth in the uterus is very obscure. The accession of fluids will account for the phenomenon; but a strong objection occurs against considering that as the cause, i. e. that the uterus increases to a certain degree in size, even although the direction of fluids be to another part, as where the fœtus is extra-uterine. Boehmerus has marked this very accurately in a case of extra-uterine conception, which he has detailed (A). The developement of its fibres seems to prove, that the increase of size depends on a certain energy of the uterus itself; perhaps this may appear a very ambiguous mode of expression, yet we can offer no other explanation of this curious phenomenon.

35 2. The great bulk of the uterus during the latter months, sufficiently explains the cause of the various complaints which occur at that period. Van Doeveren has described this very accurately. He says, "uteri gravidi incrementum, adscensus è pelvis cavo, et immanis expansio, innumeros excitat gravidarum morbos; primo quidem arctando abdomen, et mechanicè comprimendo viscera quæ in eo continentur, hepar, lienem, ventriculum, intestina, omentum, nec minus partes iis vicinas, nempe, renes, ureteres, aortam, venam cavam, arterias et venas iliacas, nervosque è medulla spinali prodeuntes inferiores; accidit pectoris coarctatio, similesque effectus inde excitati in corde, pulmonibus vasisque majoribus; ex quibus multiplici modo circulatio, digestio, chylificatio et respiratio læduntur, inque tota corporis œconomia, ejusque functionibus ingentis, solent produci turbæ variaque vitia topica excitari, inter quæ, tensiones, spasmi, dolores, stupores, obturationes, obstructiones, inflammationes, congestiones, præ cæteris memorabiles sunt; unde nascitur magna series morborum abdominis, pectoris, ipsiusque capitis; nec non artuum inferiorum torpores, dolores, crampi, œdemata, erysipelata, varices, hæmorrhagiæ, ulcera, labiorum vulvæ inflationes, variaque vitia partium genitalium, et alia multa pro diversa partium compressarum aut distentarum actione, variis nominibus insignienda (B)."

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3. The origin of the membrane, which appears about the third month, called by Dr Hunter membrana decidua reflexa, has afforded matter of dispute among physiologists. Dr Hunter imagined, that the decidua vera consisted of two layers, and that the ovum, enveloped in chorion and amnios, got somehow between these: but this is a very unsatisfactory opinion. The more probable opinion is, that the decidua vera and decidua reflexa are distinct membranes, although both formed in the same manner. If, as we have already stated, the uterus, soon after conception, be filled with a gelatinous fluid, and if the ovum be in contact with that organ at one point only, then it is probable that the vessels of the internal surface of the uterus, by shooting into the fluid with which it is covered, will form one membrane, the decidua vera; while the vessels on the external surface of the chorion, will shoot into the fluid with which the ovum must have been covered in its descent, and form another membrane, the decidua reflexa.

36

In proof that both membranes are formed in this way, it may be observed, that where the fœtus is extra-uterine, the uterus is lined with the decidua vera, and there is no decidua reflexa.—Boehmer is the first who demonstrated this; and not Dr Hunter, as has been alleged. He says, "Quum vero uterus magnitudine gravido unius circiter mensis similis videretur, eundem posterius longitudinaliter, et superius transversaliter dissecuimus, inque ejus cavo, intuitu haud impregnati satis magno, nihil præter tenacem et flavescentem mucum, mollemque poroso-villosam et valvulosam quasi turgescentem membranam undique uteri parietes et tubas investentem, hinc inde inflammatam et erosam, structuram autem uteri satis compactam invenimus *."

* Boehmer loc. cit. p. 27.

37

4. The formation of the placenta is a curious subject of inquiry. That it depends principally on the fœtus, is proved by the appearances in extra-uterine conceptions. In the case of ventral conception, published by Mr Turnbull of London, this circumstance is very clearly pointed out (C).

5. The origin of the liquor amnii has been explained very differently by different physiologists. Some imagine that it is furnished by the mother; others by the child. Baron Haller adopts the former opinion. "Ergo (he says) ab utero est, et à matre, siquidem à fœtu esse non potest. Non ausim experimentum producere, in quo crocus, quam mater sumserat, liquorem amnii tinxit †." But if this were the case, How could the liquor amnii exist when the fœtus is extra uterine? Yet it cannot be a secretion from the fœtus itself, because

† Haller Physiologiæ Lib. sectu. cause

(A) D. Philippi Bochmeri Observationum Anatomicarum variarum fasciculus notabilia circa uterum humanum continens, p. 52.

(B) Primæ lineæ de cognoscendis mulierum morbis, in usus academicos, ductæ à Gualth. van Doeveren, M. D. et Prof. p. 16.

(C) Vid. A Case of Extra-Uterine Gestation of the ventral kind, by William Turnbull, A. M. F. M. S. Lond. 1791. Plate 1st.

Effects of Impregnation.

cause it is in very large proportion when the fœtus is scarcely visible. From what source then does it proceed? Most probably from the coats of the amnios.

39 6. Since from the situation of the fœtus it has no direct communication with the atmospheric air, two questions occur on the subject; first, whether it be necessary that the fœtus should receive the vivifying somewhat which the natus receives from the atmosphere. 2dly, If this be answered in the affirmative, by what means is this somewhat furnished?

1. On looking into the works of Nature, we find that there is a class of animals placed in a similar situation with the fœtus, viz. the locomotive fishes. These receive the vivifying somewhat furnished by the atmosphere through the medium of the fluid in which they are immersed; for their blood is always distributed by the smallest ramifications over a substance in constant contact with the water, before it return into the arterial system to serve for the purposes of nutrition.

From analogy therefore it must be allowed, that the fœtus does receive, through some means or other, the vivifying principle of the atmosphere.

40 2. By what means then is this furnished? Many circumstances concur to prove that it is by means of the placenta. For,

1st, The structure of the placenta resembles much that of the lungs. It is cellular, and has the whole blood of the fœtus distributed in the smallest branches over its substance. See ANATOMY, ANIMAL, Chap. 4. SUPPLEMENT.

2dly, The blood returning from the placenta is sent by the nearest possible means to the left side of the heart. And, 3dly, Compression of the umbilical cord to such a degree as to interrupt the circulation through it, destroys the fœtus as soon as compression of the trachea does the natus.

It appears therefore that the placenta serves to the fœtus the same purpose which lungs do to the natus.

41 The celebrated Haller has objected to this probable use of the placenta in the following words. "Non pauci etiam auctores secundis pulmonis officium tribuerunt, cum in vena umbilicali sanguis ruber sit et floridus, si cum sanguinis sodalis arteriæ comparetur. Idexperimentum mea non confirmant. In pullo arteria fere coccinea, vena violacea est. In fœtu humano nunquam floridum sanguinem vidi; neque intelligo ut placenta, in qua certissime nulla sint aereæ mutabiles vesiculæ possit pulmonis munere fungi *."

* *Haller.* loc. cit. lib. xxix sect. 3. § 37.

But later observations have contradicted the assertions 42 of Haller on this occasion. In particular, Dr Jeffray, professor of anatomy in the university of Glasgow, in an inaugural dissertation published here in the year 1786, relates an experiment made by him which is completely opposite to the opinion of Haller. "Puero "he says" in obstetricatoris sinu jacenti, funiculus tribus vinculis circumjectis, et simul in arctum tractis colligatus est; quo dein juxta umbilicum inciso, in arteriis umbilicalibus et venis, inter duo vincula placentum proxime, sanguinis copia interceptum est. Intercepti spatii vasa, gelatinosa funiculi parte cultro dempta, in conspectum venerunt; et arteria, quæ sanguinem jam ante in parte circumlatum, ad placentum perferebat, puncta est; quam prope arteriæ puncturam vena quoque umbilicalis similiter puncta est. Quo facto ex vena sanguis effluens, cum eo qui ex arteria effluebat facile comparari poterat. Ille, venosi sanguinis instar, nigricabat; hic, sanguinis in adulta arteriis mox vivide florebat (D)."

Natural Parturition.

7. The means by which the fœtus is nourished have 43 hitherto escaped the investigation of physiologists. That the stomach and intestines do not serve this purpose is obvious from many concurrent testimonies; but particularly from these organs being on some occasions entirely wanting, while other parts of the system of the fœtus were complete. It is probable that the placenta supplies nourishment, as well as the vivifying principle of the air to the fœtus in utero.

CHAP. III. *Natural Parturition.* 44

HUMAN parturition, where every thing is natural, is perhaps one of the most beautiful and interesting operations in nature; for what can be more beautiful than a process accomplished by the combined action of a number of powers admirably well adapted to the intended purpose; and what can be more interesting than the continuation of our species which depends on the operation?

In treating of this subject, we shall first consider the term of gestation; 2dly, the phenomena of natural parturition; and, 3dly, the causes of those phenomena.

SECT. I. *Term of Gestation.* 45

The ancients imagined that although nine kalendar months be the most usual period of human pregnancy, yet on some occasions that period may be, and actually is, protracted even beyond ten calendar months. Accordingly, it was laid down as a maxim in ancient jurisprudence, that children born within eleven months after the death of their supposed father should be declared legitimate.

In modern times the question has been often agitated, both among medical practitioners and among lawyers. Practitioners of midwifery however have had most frequent occasion to investigate this subject, and they have differed materially in their conclusions.

Rœderer says, "Hunc terminum, finem nempe trigesimæ nonæ et nonnunquum quadragesimæ hebdomadis partui maturo natura, uti accuratior observatio docet constituit, ultraque eum non facile differtur. Nihil hic valet energia seminis deficiens, morbosa vel debilis patris constitutio, matris dispositio phthisica, hectica, qua fœtus sufficienti alimento privatur; nihil, status matris cachecticus, fluxus menstruus tempore gestationis contingens, diarrhœa aliusve morbus; nihil nimia uteri amplitudo; nihil affectus matris vehementior, qualis tristitia; nihil diæta matris extraordinaria, vel inedia; nihil fœtus debilitas et dispositio morbosa; nihil plures fœtus in utero detenti. 46

"Tantum enim abest ut hæ causæ fœtus moram in utero retardent, ut potius accelerent. Viduæ quidem vanis hisce speciebus, illicitam venerem defendere atque hereditates aucupari, quin in eo medicos nimis credulos,

(D) Tentamen medicum inaugurale, quædam de placenta proponens, auctore Jacobo Jeffray, &c. Edinburgh 1786, p. 41.

Natural Parturition.

dulos, vel lucri cupidos in suas partes trahere student, sed mera hæc sunt ludibria, prætereaque nihil (E)."

But many eminent teachers of midwifery believe that in some cases human pregnancy is protracted for two or three weeks beyond the more common period.

47 Dr Hamilton especially says, "In the human species nine kalendar months seem necessary for the perfection of the fœtus; that is, nearly thirty-nine weeks, or two hundred and seventy-three days from conception. The term does not, however, appear to be so arbitrarily established, but that nature may transgress her usual laws; and as many circumstances frequently concur to anticipate delivery, it certainly may in some instances be protracted. Individuals in the same class of quadrupeds, it is well known, vary in their periods of pregnancy. May we not, therefore, from analogy reasonably infer, that women sometimes exceed the more ordinary period? In several tolerably well attested cases, the birth appears to have been protracted several weeks beyond the common term of delivery. If the character of the woman be unexceptionable, a favourable report may be given for the mother, though the child should not be produced till nearly ten kalendar months after the absence or sudden death of her husband *."

* *Outlines of Midwifery*, p. 192.

Sect. II. *Phenomena of Natural Labour.*

48 The sufferings of a woman during labour having been compared to the fatigues of a person on a journey, the phenomena of labour have been divided into three stages. The first stage consists of the opening of the mouth of the womb; the second, of the actual passage of the child; and the third, of the separation and expulsion of the secundines.

49 *Phenomena of the First Stage.*—In most instances the bulk of the belly subsides for a day or two before labour begins; but the first evidence of the actual commencement of that process is the occurrence of pains in the belly affecting the loins, and striking down the thighs, occasioning considerable irritation of the bladder and bowels. These pains, &c. however, often take place during some hours of the night, for days, or even weeks, before true labour begins, and are then styled spurious pains. It is not easy on many occasions to distinguish true labour throes from spurious pains, unless the state of the mouth of the womb be examined, so very nearly do they resemble each other. But in general spurious pains recur at irregular intervals, and do not increase in force according to their duration; whereas true pains gradually recur at shorter intervals, and become more and more violent.

Spurious pains are sometimes attended with an occurrence which was first publicly noticed and described by the present professor of midwifery in the university of Edinburgh (F), viz. the protrusion of the urinary bladder. This resembles, to a superficial observer, the bag formed by the membranes which inclose the child, and in consequence has repeatedly been burst by the fingers of the operator. Incurable incontinence of urine, inflammation of the passages, &c. have followed this accident.

Protrusion of the urinary bladder may be readily distinguished from that of the membranes which include the infant by two circumstances. First, the bag recedes completely during the interval of the pain; and secondly, when pushed down, the finger cannot be passed round it at the fore part of the pelvis; it seems as if fixed to the pubis. True labour-pains arise from the contractions of the womb by which that organ is shortened and thickened; and, at the same time, its contents are forced through its orifice. When they become regular and forcing, they have the effect of opening the mouth of the womb, so that a practitioner can readily ascertain the difference between them and spurious pains. The opening of the mouth of the womb, in most instances, is accompanied by the discharge of a slimy, bloody-like matter, termed shews; but in many women there is no such circumstance.

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This process is generally gradual, the pains increasing in frequency and force; and eight, ten, or twelve hours, commonly elapse before they complete the opening of the womb. In some cases the dilatation takes place to a considerable extent before pains occur, so that a few pains accomplish this stage. But these exceptions are not so frequent as those of an opposite description, where one or two complete days are required to open the womb, though the pains be unremitting.

In proportion as the first stage advances, the membranous bag containing the child is pushed through the mouth of the womb, and forced gradually into the vagina. During the pain it is tense, and during the interval it becomes relaxed. When this happens, the head of the infant can be distinctly felt behind it. At last, the passages being sufficiently opened, the pains having become stronger and more frequent, the membranes give way, and the water contained within them is discharged; which finishes the first stage. Shivering, vomiting, headach, thirst, and pain in the back, take place in many instances during this stage.

50 *Phenomena of the Second Stage.*—Sometimes an interval of ease of some minutes duration succeeds the discharge of the waters. The pains then become much more violent and forcing, and the head, by the contractions of the uterus thus becoming more powerful, is pushed through the brim of the pelvis into the vagina. For this purpose the vertex is forced foremost, and the brow is turned to one sacro-iliac synchondrosis, so that the largest part of the head is applied to the widest part of the basin; for as the head is oval, and the opening through which it is to pass is of the same form, this is absolutely necessary.

After the head is in the vagina, the pains still continuing, the vertex is turned into the arch of the pubis, and the face into the hollow of the sacrum, by which the largest part of the head is brought into the direction of the widest part at the outlet. All the soft parts are now protruded in the form of a tumour, a portion of the vertex is pushed through the orifice of the vagina, and every pain advances the progress of the infant, till at last the head is expelled. An interval of a minute or two now ensues, after which another pain ta-

(E) Rœderer Elementa Artis Obstetriciæ. Goettingæ, 1766. page 98.
(F) Select Cases in Midwifery, by James Hamilton, M. D. 1795. page 16.

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king place, the face is turned to one thigh, and the shoulders of the child being placed towards pubis and sacrum, the whole of the body is born. During this process the patient generally adds voluntary efforts to the contractions of the uterus.

This stage is in many instances extremely tedious; but after the woman has had one child, it often is completed within the time of six or eight pains.

51 *Phenomena of the Third Stage.*—Whenever the infant is born, if there be no other in the womb, the parietes of the abdomen become relaxed, and the womb can be perceived through them, contracted almost into the size of a child's head. An interval of ease of some minutes duration now elapses, after which pains again recur, commonly attended with the discharge of some clots of blood; occasioning a kind of gurgling noise, and the placenta and membranes are thrown off, and the womb remains quite contracted or nearly so, with a cavity scarcely capable of containing a hen's egg. In some cases a single pain accomplishes this, and in others several pains are required; but, generally speaking, this stage is completed within an hour after the birth of the child.

It sometimes, however, happens that the natural efforts are inadequate to the expulsion of the secundines. The causes are, want of sufficient contractile power in the uterus, irregular contraction of that organ, and indurated state of the placenta itself.

From the above description it is obvious that all the three stages of labour are completed by one simple power, viz. the contraction of the womb.

52 SECT. III. *Causes of the Phenomena of Labour.*

I. The first phenomenon which requires explanation is the action of the uterus. Why does that organ generally act at a certain period, after having remained in a quiescent state for so long a time?

This question has puzzled physiologists strangely. Some have attributed the circumstance to a stimulus communicated by the fœtus: but their opinion is overturned by a well-known fact, that the same phenomena occur though the fœtus be dead. Others have imagined that the uterus is excited to act in consequence of previous distension. But were this the case, women should never have the uterus of a larger bulk in one pregnancy than in another; whereas, on the contrary, it is well known that women who have twins or triplets often have the womb distended to fully double the usual size.

Physiologists as well as physicians have fallen into very great errors from referring complex phenomena to a single cause. A variety of facts concur to prove, that in the present instance it is absurd to impute the action of the uterus to any single cause.

To what then should we attribute it? To a variety of circumstances.

1st, To the structure of the uterus. From the appearance of that organ in its unimpregnated state, it would seem that nature had laid up in store a certain proportion of fibres to be developed during pregnancy. When these fibres are evolved, if the uterus be distended farther, the edges of the os tincæ must be separated, in consequence of which part of the uterine contents passing through it, the contraction of the uterus follows. A fact very familiar to practitioners of midwifery affords apparently a complete confirmation of this hypothesis, viz. that in some women labour occurs as regularly and naturally, in the seventh or eighth month of gestation, as in others it does at the end of the ninth, the cervix uteri having become quite obliterated. Natural Parturition

2d, It is probable, however, that in ordinary cases this store of muscular fibres is seldom entirely exhausted, from the circumstance of women having sometimes twins or triplets; some other cause therefore must concur in exciting the action of the uterus. The contents of the uterus perhaps furnish this cause.

In the latter months of gestation, some parts of the fœtus come in contact with the parietes of the uterus, in consequence of the decrease in proportion of the liquor amnii. This is principally the case with respect to the head, which presses on the cervix, and that part of the uterus, it is probable, is more irritable than any other; for we find that the entrance or exit of all hollow muscular organs is more irritable than the other parts, as we see exemplified in the cardia of the stomach, and in the cervix of the urinary bladder.

3d, It is not improbable too, that the pressure of the neighbouring parts contributes somewhat to induce the action of the uterus; for it is remarked by practitioners of midwifery, that women seldom arrive at the full period of gestation in a first pregnancy, and the parietes of the abdomen yield with difficulty at first, as is observed in cases of dropsy. Besides all farmers know well, that in every succeeding pregnancy, cows exceed their former period of gestation.

II. The next phenomenon worthy of notice is the 53
manner in which the child's head enters the pelvis. Two circumstances contribute towards this, first the connection of the head of the child with the neck; and 2dly, The form of the brim of the pelvis.

The first of these circumstances has been accurately pointed out by Dr Osborn. He says, "after the os uteri has been first opened by the membranes and contained waters, forming a wedge-like bag, the next operation and effect of the labour-pains or contractions of the uterus (for they are convertible terms) must be on the body of the child, *which being united to the basis of the cranium at the great foramen and nearer the occiput than forehead*, the greater pressure will be applied to the occiput, which being likewise smaller, and making less resistance, will be the first part squeezed into the cavity of the pelvis (E)."

The latter circumstance has been clearly explained by Professor Saxtorph. He remarks, "causa hujus directionis capitis, concurrente toto mechanismo perfecti partus, potissimum hæret in pelvi. Nam agente utero in fœtum, in axi pelvis locatum, caput ejus hucusque liberum, in humore amnii fluctuans, propter molam suam majorem in introitum ipso pelvis magnam resistentiam patitur à prominentia? ossis sacri, quæ in posteriori parte segmenti inferioris uteri ita impressa est, ut promontorii

(E) Essays on the Practice of Midwifery, &c. by William Osborn, M. D.

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montorii instar fœtus frontem glabram, rotundam, unico puncto tantummodo illam tangentem et satis mobilem, blando motu ad latus dirigat, in spatium ei exactè respondens inter protuberantiam ipsam et marginem internum acutum ilii excavatum, quam ob rem, sincipitis prævii sutura sagittalis cadit necessario in diametrum obliquum aperturæ superioris pelvis (F)."

It is remarkable, that neither of these celebrated authors discovered that a combination of both the circumstances just enumerated, is necessary to occasion the phenomenon.

Two advantages result from this position of the head of the child; for, 1st, The largest part of the head is applied to the widest part of the superior aperture; and, 2dly, The head, when the occiput is forced foremost, occupies the least possible space.

54 III. The phenomenon which next strikes us, is that change in the position of the head by which the face is turned into the hollow of the sacrum.

Although the advantage, and even necessity, of this change in the position of the head, has been long known to practitioners; yet Dr Osborn is, perhaps, the first author who has clearly explained the efficient cause of this. His remarks are these: "As it (viz. the head) descends obliquely through the pelvis, the pressure of the two converging ischia will not be exactly opposite to each other on the two parietal bones; but one ischium acting or pressing on the part of that bone contiguous to the occiput, and the other on the opposite side next to the face, the head being made up of different bones, united by membranes, and forming various sutures and fontanels, which permit the shape to be changed, and the volume to be lessened, it necessarily follows, that the head, thus compressed, will take a shape nearly resembling the cavity through which it passes; and, as from the convergency of the ischia, the cavity of the pelvis somewhat approaches the form of a cone, the child's head is moulded into that shape, the shape of all others best adapted to open the soft parts, and make its way through the os externum. This unequal pressure of the two ischia upon the head, will, in the first instance, direct the occiput, or apex of the cone, to turn under the arch of the pubis, where there is little or no resistance; while the pressure of the other ischium, in its further descent, will have the same effect on the other side, and direct or compel the face to turn into the hollow of the sacrum *."

* *Dr Osborn*, loc. cit. p. 30.

This change of position is productive of three advantages.

1st, The largest part of the head is again adapted to the widest part of the pelvis.

2dly, The smallest possible surface of the head is applied to the surface of the bones of the pubes. And,

3dly, As Dr Osborn, in the passage quoted, very justly observes, the head is moulded into that shape which is best calculated to pass without doing harm, through the soft parts.

55 IV. The phenomena which occur when the head passes through the external parts, are easily explained.

After the head has made that turn, by which the face is placed in the hollow of the sacrum, the coccyx and perinæum resist its further descent in that direction, and by forcing the nape of the neck against the inferior edge of the symphysis pubis, every successive pain contributes to make the occiput rise up towards the abdomen, by which the chin leaves the top of the thorax, on which it had rested during the preceding process of delivery.

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By this simple mechanism, the soft parts are gradually prepared for the passage of the child, while, at the same time, the shoulders are brought into the most favourable position for passing through the pelvis.

V. The phenomena of the third stage of labour obviously originate from the contraction of the uterus, which both separates and expels the secundines. Some authors have imagined that nature has provided for this purpose a particular apparatus, placed at the fundus uteri; but as the placenta, when attached to the cervix uteri, is thrown off as readily as when it is attached to the fundus, it is very evident that these authors have been deceived by a seeming regularity of fibres, which is sometimes observed.

56

Lastly, The obstacles which nature has opposed to the passage of the child, occasion all the difficulties of human parturition. These obstacles are formed by the situation and shape of the pelvis, and the structure of the soft parts concerned in parturition.

57

The pelvis is situated in such a direction, that its axis forms an obtuse angle with that of the body; consequently, it is not placed perpendicularly, but obliquely to the horizon; and hence nothing can pass through it by the force of gravity.

The shape of the pelvis, too, is such, that the head of the child cannot pass through the outlet in the same direction in which it entered the brim; and, from the structure of the soft parts concerned in parturition, they yield with considerable difficulty.

By these means, the Author of our existence has guarded against the effects of the erect posture of the body, and has prevented the premature expulsion of the child and the sudden laceration of the soft parts.

Sect. IV. *Treatment of Natural Labour.*

58

First stage.—When this stage proceeds naturally and regularly, there is very little else to be done, after having ascertained that labour has really begun, and that the child is in the ordinary position, than taking care that the bowels be open, and palliating any unpleasant symptoms, such as shivering or vomiting, &c. which may occur.

But if after the pains have become so regular as, by their continuance, to disturb the ordinary functions of life, that is, most commonly, after they have been quite regular for twelve or fifteen hours; if this stage be not completed, it is necessary to interfere, and to endeavour, by art, to effect the dilatation. The reason for this rule is abundantly evident. If this stage of suffering be longer protracted, the strength of the patient must be exhausted by the long-continued exertion, and, of course, the remaining process of labour cannot be completed. Hence the child may be lost, or alarming discharges

(F) Dissertatio inauguralis de Diverso Partu, &c. Auctore Matthia Saxtorph. Hafniæ, 1771. p. 19.

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discharges of blood may follow the birth of the infant.

This very obvious effect of the protraction, beyond certain limits, of the first stage of labour, was first publicly insisted on by the present professor of midwifery in the university of Edinburgh.

The means to be adopted for completing the dilatation, when that assistance becomes necessary, are venesection or opiates, or supporting the os uteri, according to circumstances.

When the resistance to the opening of the womb arises from the premature discharge of the water, or from natural rigidity of the womb, copious blood-letting affords the adequate remedy. But if the patient be already reduced by previous disease, so that she cannot safely be bled, an opiate, in the form of glyster, ought to be administered.

And when, on the recurrence of every pain, the mouth of the womb is forced down upon the external passages before the child, its edges ought to be supported, *in situ*, by the fingers cautiously applied to each side.

59 *Second stage.*—When it is found that the head has begun fairly to enter the pelvis in the natural direction, no assistance is necessary till the perineal tumour be formed; and then such support must be given to the protruded parts as shall both relieve the distressing feelings of the patient, and, at the same time, prevent any laceration from happening. Of course, the precise manner of supporting the perinæum must be varied according to the circumstances of the case. Inattention to this has very frequently occasioned the most deplorable accidents.

After the head is born, it must be ascertained whether there be any portion of the navel-string round the neck of the infant, and if there be, it must be slackened or drawn over the head, otherwise the infant will be lost.

If possible, time should be allowed for the accommodation of the shoulders, and the expulsion of the body of the infant; and, at any rate, the utmost attention should be paid to supporting the perinæum during that part of the process.

60 *Third stage.*—When the child is born, and it is ascertained that there is no other infant remaining in the womb, the patient should be allowed to rest for a little, unless pains again come on, by which the secundines are separated. In that case, the cord is to be firmly grasped, and pulled gently, till the placenta be brought down to the external parts, when it is to be drawn out carefully, in such a manner as to bring off at the same time the complete membranous bag.

Should pains not recur at the distance of an hour after the birth of the infant, it becomes necessary, for several reasons, to introduce the hand into the womb to separate and extract the secundines.

First, If the cord were pulled by before the womb had contracted, or the after-birth had become separated, the womb must inevitably be turned inside out; an accident that has occasionally happened.

Secondly, If a longer period than an hour were suffered to elapse, the passages would become so much contracted, that the force required again to dilate them, would produce inflammation, with all its alarming consequences.

Natural Parturition.

Thirdly, If the after-birth were allowed to remain longer than an hour, excessive flooding might take place, which would soon prove fatal.

Fourthly, Were the patient to escape the danger of flooding, she would incur that of putrefaction of the placenta, which is equally, though not so rapidly, productive of mortal event.

In thus introducing the hand to separate the placenta, the two great cautions to be attended to, are to apply the fingers to the substance of the placenta, not to insinuate them between its surface and that of the uterus, and to bring off only that portion of the placenta which can be separated from the uterus without force.

When any alarming circumstance happens after the birth of the infant, requiring the extraction of the placenta, the practitioner is not to delay for an hour, indeed not for a minute, giving the requisite assistance.

Chap. IV. *Of the Deviations from Nature in Human Parturition.* 61

From the view thus given of human parturition, under the most favourable circumstances, it must be obvious that many deviations from nature may occur.

These deviations may proceed; first, from the propelling powers concerned in parturition; secondly, from the state of the secundines; thirdly, from the state of the child itself; or, fourthly, from the state of the passages through which the child is forced. There may also be a combination of these causes. We shall consider each of these causes of deviation in the order just enumerated. But as a minute investigation of the subject would far exceed the necessary limits of this work, we shall treat each of these causes as shortly as possible, and notice only the most striking circumstances.

Sect. I. *Of the Deviations from Natural Labour, which proceed from the Propelling Powers.* 62

The propelling powers concerned in parturition consist of voluntary and involuntary muscular action. The diaphragm and abdominal muscles furnish the former, and the uterus the latter.

An excess or diminution of the action of those powers must interrupt the ordinary progress of labour.

a. The violent action of the diaphragm and abdominal muscles, if exerted at the beginning of labour, tends to exhaust the patient and to retard delivery, and if induced when the head is within the vagina, may, provided proper precautions be not taken, lacerate the perinæum, and render the future life of the patient miserable. 63

The action of these muscles being quite voluntary, may be readily prevented by the patient submitting to proper advice.

b. Impaired action of the diaphragm and abdominal muscles, generally originates from the improper exertion of those muscles at the beginning of labour, or from passions of the mind. It always retards delivery, and consequently protracts the sufferings of the patient. 64

c. Violent

Preternatural Parturition.

65

c. Violent action of the uterus at the beginning of labour, is frequently productive of much mischief. It exhausts the patient, and renders the subsequent process of delivery exceedingly tedious and difficult. It also sometimes occasions an accident which generally proves almost immediately fatal, viz. rupture of the uterus.

This accident has been described by authors under the title of spontaneous rupture of the uterus. The laceration in the uterus in those cases is sometimes transverse and sometimes longitudinal. When the accident happens from this cause, the laceration is most frequently in the cervix. The accident is preceded by excruciating pain, especially during the action of the uterus, at one part, as in the loins or towards the pubes; and it is announced by a most agonizing increase of the pain, succeeded by violent vomiting, the discharge of a little blood, a total cessation of the labour throes, very great irregularity and feebleness of the pulse, cold sweat, coldness of the extremities, difficulty of breathing, inability to lie in the horizontal posture, and sometimes delirium. Along with these symptoms, it often happpens that the presenting part of the child recedes entirely, and the limbs of the infant may be readily distinguished through the parietes of the abdomen. But this circumstance does not always take place, for sometimes the head of the child is so firmly wedged within the pelvis, that it does not recede although the other parts be in the cavity of the abdomen.

The rupture of the uterus is generally fatal. A few cases, however, are on record, where, by prudent management, the patient, even under such dangerous circumstances has been saved. Such are the cases recorded by Dr Hamilton (H), by Dr Douglas (I), and Dr Hamilton, junior (K). But the injuries which must ensue from loss of blood, acute pain, the presence of the child in the cavity of the abdomen, and the probable protrusion and strangulation of the intestines, are such, that it cannot be expected that many patients can survive the accident.

The cause of violent action of the uterus at the beginning of labour, is obviously the premature discharge of the liquor amnii. By this circumstance, the body of the child comes in contact with the parietes of the uterus, by which the action of that organ is immediately and violently excited. How much mischief then may the rash interference of an ignorant operator produce?

The cause of rupture of the uterus from its own violent action, is the resistance to the passage of the child, either from undilated os uteri, or from deformities of the pelvis, or from wrong position of the child. Whenever, therefore, the rupture is threatened, means must be instantly adopted to remove the resistance, or to suspend the action of the uterus. The former is in general the more easily accomplished.

When the uterus has actually burst, the only chance which can be afforded to the patient, is instant delivery; *per vias naturales*, where that is practicable; and where there is extreme narrowness of the pelvis, by an incision through the parietes of the abdomen. A case where this latter practice was successfully had recourse to occurred a few years ago in Lancashire.

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Violent action of the uterus during the latter stage of labour, although not productive of the same dangers which ensue from it at the beginning, is by no means exempt from hazard; for if the soft parts be rigid or not sufficiently relaxed, the woman may be miserably torn.

The violent action of the uterus towards the termination of labour proceeds from some power of that organ itself, or from the stimulus communicated by the position of the child.

This circumstance, however, is sometimes beneficial; as, for instance, when the child is in an unfavourable position. Dr Denman was the first who discovered this effect of violent uterine action, and published it in the fifth volume of the London Medical Journal, page 64.

66 *d.* Impaired action of the uterus during the first stage of labour is in many instances productive of no other inconvenience than the protraction of labour; but if it exhausts the strength of the patient, it influences materially the subsequent process, as already stated. When it occurs during the second stage, it occasions the most dangerous symptoms. First, if the head of the child continue to press for a considerable time on the soft parts within the pelvis, these parts must necessarily from the impeded circulation become swelled, and consequently the action of the uterus, though it should return, would then be totally insufficient for the expulsion of the child. This effect of the protraction of the second stage was first pointed out to the public in Dr Hamilton's letters to Dr Osborn. It merits most particular attention; not only as it is one of the most frequent causes of the loss of the infant during labour, and of considerable danger to the parent, but also as it may be very readily prevented by an attentive practitioner. Previous to this swelling becoming so considerable as to impede the progress of the infant, there is a tenderness and heat, and dryness in the passage, which announces the actual commencement of the inflammation. Immediate delivery ought then to be had recourse to.

Many disagreeable symptoms also proceed from the same cause, such as suppression of urine, and violent cramps in the lower extremities.

When it is ascertained, that, in consequence of the deficiency of action of the uterus, the child is detained so long in the passage as to endanger the health or life of the mother, it becomes necessary to extract the infant by mechanical means. Two contrivances have been thought of for this purpose, viz. the vectis or lever, and the forceps.

67 Roonhuysen, a Dutch practitioner, who flourished about the beginning of the 18th century, contrived the vectis, and from the great success which attended its use in his hands, an edict was issued by the states-general, that no surgeon should practise midwifery without

(H) Outlines of Midwifery, p. 348.
(I) Observations on the rupture of the gravid uterus, &c. by A. Douglas, M. D. &c. 8vo. London 1789.
(K) Select Cases of Midwifery, p. 138.

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out being possessed of the Roonhuysen secret, for the instrument was not publicly known. In the year 1756, however, the secret having been purchased by two liberal-minded physicians, Vischer and Van de Poll, was published by them for the benefit of mankind. Since that time, the instrument has undergone a variety of alterations in its form; for a particular account of which, the reader is referred to Mulder's Historia Forcipis.

There can be no doubt that Roonhuysen and his successors employed the vectis as a lever of the first species, the head of the infant being the resistance, the parts of the woman the fulcrum, and the hand of the operator forming the moving power. The injuries arising from this practice have been well explained by Dr Osborn in his Essays on Laborious Labours. Although Dr Bland and Dr Denman still recommend the same practice, there can be no doubt that whenever the use of the vectis proves successful according to their directions, the fortunate termination is to be attributed to the action of the uterus being excited by the pressure of the instrument; or, in other words, the delivery might have been completed without any mechanical interference at all. On the other hand, whenever the action of the uterus is either quite suspended or much weakened, both mother and child suffer from the application of the vectis.

63 The late Dr Dease, in altering the shape of the vectis, wished to impress upon the profession the necessity for changing the mode of employing it; and accordingly he called his instrument an *extractor*. This power, however, seems to be possessed in a superior degree by Dr Lowder's instrument, of which a description is contained in the eighth volume, second decade, of Dr Duncan's Medical Commentaries, p. 400. As this instrument may be used with perfect safety, both to mother and child, and as in some cases it is superior to the forceps, we have represented its form in one of the plates, and now add the description and an account of the manner of applying it from the work already referred to.

69 The instrument "consists of a blade and handle (between which there is a hinge, that renders it portable), measuring in length 11½ inches. Its length, before it be curved, is 12½ inches. The curve begins about half an inch from the hinge. It describes, reckoning an inch from its first curvature, as nearly as can be estimated, an arc of 87 degrees of a circle, the radius of which is four inches. The breadth of the blade, at the beginning of the curve, is half an inch, and is gradually increased, till within three quarters of an inch of the extremity, where it measures an inch and three-fourths. Its extremity is semicircular. Within 2½ inches of the extremity there is an oval opening, measuring 2¼ inches in length, and 1¼ at its greatest breadth. By this opening, the depth of the curve is considerably increased, without rendering the instrument inconvenient in its introduction."

70 "Let us suppose that it is found necessary to use Lowder's lever, when the head of the child has just begun to enter the cavity of the pelvis. The patient is to be placed in the ordinary position, on the left side, in bed. The occiput of the child is to be carefully distinguished, and the curve of the instrument is to be applied, with all the necessary precautions, over it. The extremity of the blade should be within a very little of the nape of the neck. To accomplish this part of the operation with facility, it is necessary that the operator be well acquainted with the shape of the pelvis, and that he have accustomed himself to apply the instrument over a round substance.

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"When the instrument is applied in this manner, the operator will find, that he can exert very considerable power in drawing down, without pressing on any other part than the occiput of the child. The mother cannot possibly feel the instrument; while, at the same time, the many points of the fœtal cranium, on which it rests, prevent any injury whatever to the infant.

"If there be any pains, however slight they may be, the operator should draw down only during the pain: in the intervals, a soft warm cloth should be wrapped round the handle. If there be no pains, he must draw down from time to time, imitating, as nearly as he can, the natural efforts. It is astonishing, of what use even the most trifling pains are, on such occasions. Without pains, a long time is required before the head be made to advance in a perceptible degree (though, after it has advanced a little, it soon yields entirely); while, with them, the progress is often rapid.

"The operator should continue to draw down in the same manner, till the head be completely in the cavity of the pelvis. Should any circumstance, as dangerous uterine hæmorrhagy, or convulsions, require that the delivery be expeditiously finished, after the head is brought into this position, the forceps must be applied; for it is in the power of the operator, by means of them, to accomplish the extraction of the head within a very short space of time, or at least, within a much shorter space than would be required, were the use of Lowder's lever continued.

"But if there be no dangerous symptom, the operation may be completed by the first instrument, without any assistance from the forceps.

"For this purpose, the operator should continue to draw down, by pressing on the occiput, as already directed, until the face shall have turned into the hollow of the sacrum. The direction of the instrument must then be changed. The reason of this is very obvious. After the face is in the hollow of the sacrum, the occiput becomes engaged in the arch of the pubis, and rises under it, while, at the same time, the chin leaves the top of the breast, on which it had rested during the preceding process of labour, and describes a course equal to a full quarter of a circle, which is the consequence of the occiput describing a similar course under the arch of the pubis. Were the practitioner then to continue to press in the same direction as he did while the head was passing through the brim, he would counteract this natural process, and hence would retard delivery, and injure the parts against which he would necessarily press the child.

"The instrument must, therefore, be withdrawn from the occiput, and applied with the proper precautions over the chin, when the operator is to imitate the process of nature, by disengaging the chin from the breast, and making the occiput rise under the arch of the pubis, while, with his left hand, he protects the perinæum from injury."

"From these observations it is obvious, that the instrument introduced into practice by Dr Lowder, affords exactly the assistance, in the first order of laborious labour, which is required; for it supplies the place of the

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propelling powers, or increases their efficacy, by acting on the body of the child, without injuring any part of the mother.

71 "This property renders it of great use in certain cases of deformed pelvis, viz. where the short diameter of the brim is about three inches. In such cases, the long continued strong action of the uterus, often eventually forces the head into the pelvis; but the strength of the patient is in consequence so much reduced, that after it has proceeded so far, the pains are entirely suspended, and the delivery must necessarily be finished by the use of mechanical expedients; but the child's life is commonly previously destroyed, by the compression of the brain.

"If, in such cases, it be possible to increase with safety the vis à tergo, the child would then be forced through the brim of the pelvis before the woman's strength were exhausted, and before its life were endangered; consequently, many children, commonly doomed to inevitable destruction, would be preserved.

"Lowder's lever, I apprehend, possesses this power. It may be calculated, that, by its use, the efficacy of the labour throes is at least doubled. Hence the child, in cases of slight deformity of the pelvis, is forced through the opposing part within one half of the time which would be otherwise required; and this is accomplished without injury either to the mother or infant; for the instrument presses on no part of the former; and it rests on such parts of the latter, that no harm can possibly be done.

"In face-cases, too, where the interference of the practitioner is necessary (which, indeed, is a rare occurrence), this instrument may be employed with much advantage. The great aim should be, to draw down the occiput.

"As it appears, therefore, that Lowder's lever is applicable in many cases where the forceps are inadmissible, and that its use is not productive of so much hazard to the mother as that of the forceps, it might perhaps be inferred, that the latter instrument may be banished from practice, as unnecessary and dangerous. Accordingly, many practitioners of midwifery have adopted an opinion of this kind; and, indeed, there are very few who do not employ one or other of these instruments exclusively.

"But however desirable it may be to lessen the number of mechanical expedients, and to simplify practice, I apprehend, that many lives would be lost if we possessed or employed no such instrument as the forceps. As they have the property of a lever, delivery can in many cases be accomplished much more expeditiously by them than by Dr Lowder's instrument. This seems to be the sole advantage which they possess over it; and that is counterbalanced by several great disadvantages. Many authors, indeed, have alleged, that the forceps have exclusively the power of diminishing the size of the fœtal cranium, by the pressure of their blades, and hence have attributed a degree of pre-eminence to them, which in fact is not their due; for as the size of the child's head is, in natural cases, diminished as far as is necessary, by the contractions of the uterus forcing it forward through the bones of the pelvis, an increase of the vis à tergo will of course increase that diminution, if the shape of the passage require it. While Lowder's lever, therefore, possesses the power of compressing the cranium in common with the forceps, it has a decided superiority over them in this, that it accomplishes that end by similar means with nature.

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"The great disadvantages of the forceps are, that they are inapplicable when the child's head is situated high in the pelvis; that their application is often difficult to the operator, and painful to the patient; and that, as their centre of action is on the parts of the patient, they must injure her in proportion to the resistance opposed to the delivery.

"On the whole, then, in cases of the first order of laborious labours, both instruments must be occasionally had recourse to. When the head is not completely within the cavity of the pelvis, Lowder's lever must be employed; and even when it is in that position, the same means may be used, if there be pains. But, when the labour throes are entirely suspended, or when any circumstance renders it necessary to terminate the delivery with expedition, the forceps ought to be employed in preference to every other instrument, if the head of the child be within their reach."

The forceps are supposed to have been invented by 72
Dr Hugh Chamberlain, who was physician to King Charles II.; but their form has been greatly altered since his time. The most approved form is that represented in the plate.

This instrument is only applicable in presentations of the head; but it was formerly, by Dr Smellie and others, recommended in face cases.

In order that this instrument be applicable, it is necessary that the head be completely, or nearly so, in the cavity of the pelvis; but sometimes a lengthened pair is used for cases where the head is situated high. The employment of long forceps, however, being extremely dangerous, is seldom justifiable; and therefore we shall limit our directions to the use of the common short forceps.

There are three principal cases in which that instrument may be had recourse to, viz. 1. where the face is in the hollow of the sacrum; 2. where the face is wedged under the pubis; and, 3. where it is on one side of the pelvis. 73

In whatever situation the head is, the instrument is to be applied over the ears, otherwise there could be no safe and secure hold. In the process of extracting the child with this instrument too, it is to be observed, that the convex edge of the blades is to be brought along the hollow of the sacrum.

The instrument being applied so cautiously over the ears of the infant that no part of the woman be injured by their introduction, the locking parts are to be brought together, and secured by a ligature; after which the operator, supporting carefully the perinæum with one hand, is to draw gently in a direction of from blade to blade during a pain, or now and then to imitate labour throes, while he at the same time favours the mechanism of labour by accommodating the child's head to the passage so as to make it take up the least possible room. If this be done with suitable caution and gentleness, no part of the woman should be injured, and the parts of the infant on which the instrument had rested should not even be marked. But as there can be no doubt, that in the process of using the forceps, the parts of the woman are pressed upon by the blades, if much force be exerted, or if due attention be not

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not paid to the adaptation of the head of the infant to the apertures through which it is to be brought, the most dreadful effects result from the operation.

Sect. II. *Of the Deviations from Natural Labour, which proceed from the state of the Secundines.*

74 The membranes which envelope the fœtus are in some cases more tender, and in others more rigid, than in general they are found; circumstances which have a considerable effect on the process of parturition. Besides this, the placenta is on some occasions attached to the cervix or os uteri, by which not only is the order of labour interrupted, the placenta being expelled before the child, but also is the patient's life exposed to much danger.

75 *a.* Where the membranes are too tender, the liquor amnii is discharged at the beginning of labour before the os tincæ be dilated, and then all the bad consequences detailed under the article *b*, Sect. I. necessarily ensue.

b. Where the membranes are too rigid, the labour may be protracted to such a period as shall injure the mother most materially, and at last, as the whole ovum may be expelled entire, the life of the child may be endangered.

After the os uteri is completely dilated, if the child included in the membranes do not advance into the cavity of the pelvis, the membranes should be ruptured. But if it do, they ought not to be broken till they press on the external parts.

c. But the most alarming deviation from nature, which can proceed from the state of the secundines, is that which originates from the attachment of the placenta over the cervix or os uteri. As there can be no doubt that the uterine vessels dip into the substance of the placenta, and that they are lacerated when the placenta is separated from its attachment, it is obvious that in such a situation hæmorrhagy to a most dangerous extent must unavoidably ensue during the process of the labour.

76 Mr Rigby of Norwich was the first British practitioner who publicly explained this cause of hæmorrhagy. In the first edition of his work; viz. that published in 1775, he expresses himself in the following words. "But from the uncertainty with which (as before observed) nature fixes the placenta to the uterus, it may happen to be so situated, that when the full term of pregnancy is arrived, and labour begins, a flooding *necessarily* accompanies it, and without the intervention of any of the above *accidental* circumstances; that is, when it is fixed to that part of the womb which always dilates as labour advances, namely, the collum and os uteri, in which case it is very certain that the placenta cannot, as before described, remain secure till the expulsion of the child, but must of necesssity be separated from it, in proportion as the uterus opens, and by that means an hæmorrhage must *unavoidably* be produced.

"That floodings, which arise from these two different causes, which I will distinguish by the names of *accidental* and *unavoidable*, though they may appear exactly similar in their first symptoms, should terminate very differently, if left to nature, assisted only by the palliative means before mentioned, cannot seem strange; nor can it be a doubt, that of these two kinds of floodings, only one of them, namely, that which is produced by an accidental separation of the placenta, can be relieved by the use of these palliatives; and that the other, in which the placenta is fixed to the os uteri, and the flooding is therefore *unavoidable*, cannot possibly be suppressed by any other method whatever than the timely removal of the contents of the womb; for supposing the discharge to be for a while restrained by bleeding, medicine, cool air, &c. it will inevitably return, when nature is so far recovered as again to bring on labour: in the first case, if the hæmorrhage have been checked by the use of the above means, it is not impossible but labour may come on, and the child be safely expelled by the natural pains before it returns; or if it should return, it may not increase in quantity; as in this case very probably the separated part of the placenta which occasions the discharge remains nearly the same; whereas in the other case, in which the dilatation of the os uteri produces the separation of the placenta, every return of pain must be a return of the bleeding, and it must become greater and greater as the uterus opens more and more, and the placenta is in proportion detached, till it increases to a degree that exhausts the patient, and she dies before nature has been able to expel the child. That such must inevitably be the progress and event of floodings arising from such a cause, if left to nature, is too obvious further to be insisted on.

"That this attachment of the placenta to the os uteri is much oftener a cause of floodings than authors and practitioners are aware of, I am from experience fully satisfied, and so far am I convinced of its frequent occurrence, that I am ready to believe that most, if not all of those cases which require turning the child are produced by this unfortunate original situation of it (L)."

77 No case in practice requires more decision and more attention than this. It must be obvious that no internal remedy can be of any avail in flooding from such a cause, and that the life of the patient can be saved by immediate delivery alone, whenever considerable hæmorrhagy takes place. But it is to be recollected that the discharge in many instances threatens for days or even weeks before it becomes serious, and that for the sake of the child, the patient should be allowed to advance as near as her own safety will permit to the full period. These threatenings may often be removed by astringent injections, per vaginam, while at the same time every means of moderating the circulation of the blood should be suggested.

But whenever the discharge becomes profuse, delivery by art is to be had recourse to. The rule of Mr Rigby, and of some other eminent practitioners, "to watch from time to time the dilatability of the os uteri," and take advantage of that state, sounds well; but

(L) Essay on the Uterine Hæmorrhagy which precedes the delivery of the full-grown Fœtus, illustrated by cases by Ed. Rigby, London 1775, p. 14. Vide also 3d edition 1784, same page.

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but if followed in practice, must either give such a shock to the woman's constitution, as shall end in dropsy or marasmus, or must prove immediately fatal. In all those cases the os uteri may be forced, and although it be not more open than barely to admit the introduction of the finger, it may in a very few minutes, if the operator have steadiness and perseverance, be rendered capable of allowing the hand to pass.

If possible, the hand should be carried forward at one side of the placenta, for if that part be torn (which it must be admitted is sometimes inevitable) the infant must be destroyed. After the feet are brought down, the child is to be extracted as expeditiously as regard to its safety will permit, and the hand is then to be again passed into the uterus for the purpose not merely of detaching completely the secundines, but chiefly of securing the contraction of that organ which is the great object of the delivery.

78 SECT. III. *Of the Deviations from Natural Labour, which proceed from the state of the Child.*

The regular process of parturition may be interrupted, in consequence of the position and of the shape of the child.

79 1. *Position of the child.* The most natural position of the child, at the beginning of labour, is with the head placed at the brim of the pelvis, the face towards the sacro-iliac synchondrosis of one side, and the occiput towards the groin of the opposite side. But there are many deviations from this natural position.

80 *a.* Although the head be applied to the brim of the pelvis, it may be forced with the sinciput towards the promontory of the sacrum, and the occipit towards the symphysis pubis. In this situation the largest diameter of the head is opposed to the smallest of the pelvis, consequently the head remains firmly fixed in that position, for as the sinciput cannot advance a point beyond the promontory of the sacrum, the occiput is forced just so much below the brim at the pubis as to wedge the head firmly between the sacrum and pubis. By the long-continued pressure the soft parts become much swelled, and at last the head is found so immoveably fixed, that it can neither be made to recede, nor can it advance in the same direction. This constitutes what has been styled the *caput incuneatum*, or, as it is called by French practitioners, *la tête enclavèe*. This case most commonly is the effect of mismanagement; for if a very little pressure be made on the head when it presents at the brim of the pelvis in this unfavourable position, the pains will readily force it into the passage in the proper direction.

When the locked head has actually taken place, the practice must be varied according to the circumstances of the individual case; hence the long forceps, and sometimes even the crotchet, are required. Turning is quite inadmissible, and the three-bladed forceps so strenuously recommended by Dr Leake, in this case are totally inapplicable.

81 *b.* The long diameter of the head may also be applied to the short diameter at the brim, in a different manner, viz. with the face towards the pubis, and the occiput to the base of the sacrum. The obstacles to the progress of the head are not in this case so great as in the former (*a*); for as the occiput is round, and its surface inconsiderable, while at the same time the promontory of the sacrum is round, the labour throes, after some time, force the occiput either a little to one side, or at least past the promontory. The case, however, is tedious, painful, and even dangerous to the patient; for as the face presents a larger surface to the pubis than the occiput, it must require longer time to pass, and as there are many inequalities on the face, the patient must suffer much pain from their pressure, and from the same circumstance must incur the hazard of having the urinary bladder or the urethra irreparably injured.

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82 In this case Professor Saxtorph remarks, "vel occiput primo descendit, quod cum accidit, frons ab ossibus pubis sustentata elevatur, mentumque pectori infantis imprimitur, urgentibus porro doloribus, versus anum et perinæum, adagitur acuminatum occiput, et nullo modo sub arcu ossium pubis extorqueri potest inflexile sinciput, hinc partus in exitu pelvis impossibilis redditur."

That this is a mistake, the observation of other practitioners has sufficiently demonstrated; for it is well known that in such cases, after the perinæum has been much stretched the occiput is forced through the parts, and immediately slips back towards the anus, while the nape of the neck being applied to the anterior edge of the perinæum, moves on it as on an axis, so that the sinciput and face emerge from under the symphysis pubis, the chin leaving the top of the thorax in the same manner as if the face were situated naturally in the hollow of the sacrum.

Although in this case the natural efforts most ordinarily complete the process, yet in many instances the injury which threatens the urinary bladder renders the application of the forceps expedient.

83 *c.* Although the head may have entered the pelvis in the most natural position, yet it may not make those changes in situation which are required to accommodate it to the outlet; for the face may turn under the symphysis pubis instead of into the hollow of the sacrum. When this happens the phenomena already described (*b*) take place.

84 *d.* It sometimes happens, that instead of the smooth part of the cranium being forced first into the pelvis, the face presents. In this case it may be situated in three positions, viz. with the chin to the sacrum, or pubis, or side.

a a. The first case is esteemed the most dangerous both for the mother and child. For the mother, because the child in this position requires more room than the pelvis affords, consequently the soft parts in contact with the chin and smooth part of the cranium are much compressed, and hence if the delivery be not speedily accomplished, much injury to those parts will ensue. As the chin too must pass along a curved line formed by the sacrum and coccyx, the obstacles to delivery are very great; and even after the face has been forced so low as to press on the perinæum, that part is in much hazard of being torn by the violent distension which it undergoes. The delivery in such cases is very rarely accomplished naturally.

This species of labour is equally dangerous to the child as to the mother, not only on account of the long-continued pressure on the brain, but also from the occiput being forced so strongly on the superior dorsal vertebra that the free return of the blood from the head is

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interrupted, and hence apoplexy ensues; a circumstance which is proved even by the appearance of children who in such cases are born alive, for the face of such children is perfectly livid. Jacobs has pointed out these dangers pretty accurately. "Il est dangereux pour l'enfant, (he says), parce que la tête etant penchée et portant sur son cou, elle comprime les vaisseaux sanguins au point que le sang ne pouvant plus circuler, il meure d'une apoplexie pour peu que l'on tarde á l'extraire." *Ecole pratique des Accouchemens, par le Professeur J. B. Jacobs. A Paris*, 1785. p. 366.

b b. The second case, viz. where the chin is placed towards the pubis and the sinciput to the sacrum, is neither so dangerous for the mother nor child. For if by the force of the pains the face be pushed so far forward that the chin becomes engaged within the arch of the pubis, then the inferior edge of the symphysis pubis forms a fulcrum on which the inferior jaw moves, by which the sinciput and occiput pass readily and easily along the hollow of the sacrum, their surface being well adapted to that of the sacrum, and the several parts of the face pass in succession through the vulva.

cc. The third case, viz. where the chin is to one side, is still more favourable than the second; for the face passes readily through the oblique diameter of the pelvis till stopt by the tuberosities of the ischia, when the chin turns into the arch of the pubis, and then the same phenomena which occur in the second case take place.

The cause most generally assigned for face-cases is the ill directed exertion of the propelling powers. May it not also depend in many cases on the original position of the fœtus?

When any extraordinary difficulty occurs in face-cases, Lowder's lever is the instrument to which recourse ought to be had. The forceps, as recommended by Smellie and others, being quite insufficient to afford a safe and secure hold of the infant.

85 *e.* On some rare occasions the side of the head presents, so that one ear is in the centre of the pelvis. In such a case, the strongest contractions of the uterus cannot make the head enter the pelvis, and the woman would generally die undelivered were it not for the interference of art. Cases of this kind are remarkably rare.

The hand of the operator must be carried up in such cases, and moderate pressure must be made in such a direction as shall allow the contractions of the uterus to push the smooth part of the cranium into the cavity of the pelvis.

86 *f.* The head of the child is not the part always applied to the pelvis; for sometimes the head passes last. Whenever any other part than the head presents, the labour is styled by authors *preternatural.*

All preternatural labours have been divided into two orders. A. Presentations of the inferior extremities; and B. Presentations of the superior extremities.

A. Presentations of the lower extremities comprehend cases where one or both feet, one or both knees, and the breech present.

87 *g.* Cases where both feet present are more frequent than those where one only presents. It has been calculated that the feet present once in 105 cases of labour.

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Some authors have divided labours of this kind into a great variety of species. There is, however, no necessity for such divisions, and they tend to mislead and embarrass practitioners. All the varieties may be reduced under three heads; for the toes must be either towards the side of the pelvis, or towards the sacrum or pubes.

d d. Where the toes are towards the side of the pelvis, the child is generally placed in such a manner that the abdomen, breast, and face pass in succession along the sacro-iliac synchondrosis of that side. This is the most favourable situation in which the child under such circumstances can be placed; for the largest parts of its body pass through the largest aperture of the pelvis.

In this case, then, the action of the uterus forcing forward the child, the feet are by degrees excluded through the external parts, the toes being situated between the point of the coccyx and the tuberosity of the ischium; the thighs follow, then the abdomen and thorax; but the farther progress of the child is for some time interrupted by the arms passing up along each side of the head, which add considerably to its bulk; at last, however, the repeated contractions of the uterus force the face into the hollow of the sacrum, and then the nape of the neck turning on the inferior edge of the symphysis pubis as on a pivot, the face is excluded, followed by the sinciput and occiput.

Where the efforts of nature in this process are solely trusted, the child, unless it be small and the pelvis be very capacious, while the soft parts are much relaxed, is generally still-born; for before the obstacles to the delivery of the head be overcome, the long-continued compression of the funis umbilicalis, by intercepting the course of the blood, proves fatal.

e e. Authors have generally considered that to be the most favourable position in which the feet can present, where the toes are towards the sacrum. Roederer for example says, "pedum tunc digiti si ossi sacro obvertantur, fœtus abdomini incumbens recte situs est (L.)" But two disadvantages attend this position: First, the largest part of the child's body is forced through the smallest part of the outlet of the pelvis; and 2dly, The longest diameter of the head is applied to the shortest diameter of the brim of the pelvis. In such cases, therefore, the patient commonly suffers much pain, and the child's life is destroyed.

f f. When the toes are turned to the pubes, it has been universally acknowledged, that the feet are in the worst possible position. Indeed not only do the disadvantages stated as resulting from the last position (*e e*) equally take place in this one, but another cause of difficulty and danger is added, viz. that the face being applied to the pubes, the progress of the child must be impeded in no inconsiderable degree. Hence in such a case the patient may be very much injured, and the child must be almost inevitably lost.

The management of footling cases was first explained, in as far as we know, in Dr Hamilton's Select Cases in Midwifery, p. 89.

"It

(L) Roederer Elementa Artis Obstetricæ, p. 249.

Preternatural Parturition.

88 "It is a curious circumstance that the best mode of delivery in footling cases has not yet been explicitly pointed out by any author. This must appear surprising when it is considered that such presentations frequently occur; that the life of the child depends upon the practice adopted; and that the management of every preternatural labour must be influenced by the rules applicable to footling cases.

"When the feet present, the infant's situation relatively to the mother must be with its belly placed towards her back, her belly, her side, or some intermediate point. The first of those positions has been generally considered as the most favourable, and the last as the reverse. But a little reflection must convince every practitioner that the infant occupies the least possible space, when its belly is towards the side of the mother, or, to speak more accurately, towards the sacro-iliac synchondrosis; for then the largest part of its body is within the largest diameter of the pelvis at the brim, while in its progress through the pelvis, the breech is not forced through the shortest diameter at the outlet, viz. that between the tuberosities of the ischia.

"In every case therefore where the feet are brought down, the toes should in the process of extraction be turned into such a position, that the belly, the breast, and the face, shall be made to pass in succession along the nearest sacro-iliac synchondrosis. After the arms are disengaged, the face can be readily turned into the hollow of the sacrum."

89 *h.* One foot may present in the same variety of directions as both feet. Where one foot presents naturally, if the pains be regular and strong, the case is attended with less pain to the mother and less danger to the child, than where under similar circumstances both feet present. It is less painful to the mother, because the child is formed into the shape of a cone, and the apex passes first through the pelvis, by which the parts are gradually prepared, and not suddenly forced open; and it is less dangerous for the child, because the one leg being folded along the belly and breast, the umbilical cord is protected from compression.

From these circumstances, a very erroneous inference has been deduced by some celebrated authors, viz. that in cases where it is necessary to perform the operation styled turning, the one foot should be brought down in preference to both. But as on such occasions the operator cannot be assisted by pains, it is obvious that he could not have a sufficient hold of the child by a single foot.

With the exceptions just stated, the phenomena where one foot presents are the same with those which occur in cases where both feet are in the passage.

90 *i.* When the knees present, all the inconveniences of footling cases take place, with this additional danger to the child, that if the legs be crossed, one or both may be fractured before the knees be expelled.

The management of knee presentations must depend on the advance which these parts may have at the time assistance is procured. If they be still at the brim of the pelvis, the feet should be hooked down. But if they be fairly within the cavity of the pelvis, or in the vagina, they must be allowed to protrude without the parts until the feet be expelled.

91 *k.* Breech cases occur more frequently than footling ones. It has been calculated that they happen once in 52 cases of labour. Preternatural Parturition.

The breech may present in the same variety of positions as the feet, viz. with the belly of the child to the back, to the belly, or to the side of the mother. Certain advantages and disadvantages attend each of those positions.

When the belly is to the back of the mother, the thigh bones being straight, pass with difficulty along the curved line of the sacrum; after that obstacle is surmounted, the largest part of the child is applied to the smallest diameter at the brim of the pelvis; and after the body is delivered, the head is situated in such a direction that it cannot enter the brim; for the sinciput is opposite to the promontory of sacrum and the occiput to the symphysis pubis.

If the belly of the child be to the belly of the mother, then the thigh bones pass very readily along the bones of the pubes, while the spine bending, accommodates itself admirably to the hollow of the sacrum, consequently at first the labour proceeds speedily and safely; but after the breech has passed through the cavity of the pelvis, it is applied with its largest diameter to the shortest diameter at the outlet, and after it has at last overcome the resistance occasioned by that circumstance, and the body is expelled, the face, being towards the symphysis pubis, subjects the patient to all the pain, and the child to all the dangers, already enumerated (*ff*).

When the belly of the child is placed towards the side of the mother in breech cases, then the same advantages attend the situation which have been enumerated under the first footling case (*dd*); for the largest part of the child is uniformly applied to the largest aperture of the pelvis. Besides this, the child incurs less hazard in this position than where the feet originally present; for the legs being folded on the belly protect the funis umbilicalis from compression.

Breech cases, where the pains are powerful, are to be left entirely to nature, taking care to support the perinæum, till the infant be expelled; the navel-string is then to be taken off the stretch, and the child accommodated to the passage on the same principle as footling cases.

When the pains prove inadequate to the expulsion of the breech, various methods have been recommended, such as hooking the finger in the groin, first on the one side, and then on the other; employing a blunt hook for the same purpose; fixing a garter or piece of tape over one or both thighs, and applying the forceps.

The first of these methods are useful where there are slight pains, and the infant is not large. The second and third methods are injurious both to the mother and child, for they add to the vis à tergo, without diminishing the resistance. But the fourth method, that is, applying the forceps, is invariably both safe and successful; because, while it enables the practitioner to draw forward the child without any uterine action, it at the same time puts it in his power to accommodate it to the passage by turning it round in the proper direction.

B. The second division of preternatural labours, includes all cases where any other part than the head or lower extremities presents; such as the neck, the arm or shoulder, the breast, the back, the belly, or the side.

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It is obvious, that a full-grown child cannot possibly be expelled through the natural passages in such positions, and consequently, unless nature perform the operation first described by Dr Denman, both mother and child must be destroyed; for the unavailing contractions of the uterus will first operate in impeding the circulation of the child; and then by pushing forward its body with great force on the soft parts of the mother, will induce such a degree of pain and inflammation, that she must at last sink exhausted.

93 The practice of turning, as it is called, that is, of bringing down the feet in cases belonging to this division of preternatural labours, originally suggested by Pierre Franco, but first properly established by Ambrose Parrè, has been the means of saving many valuable lives. Indeed the superiority of this practice to that of making the present under such circumstances must be very obvious; for after the operator has got hold of the infant's feet, he can complete the delivery without requiring the assistance of pains.

The dangers to be dreaded in performing the operation of turning are rupture of the uterus, or subsequent inflammation of the passages, and loss of the child.

The first of these, is to be guarded against, by pursuing such means as shall suspend the labour-pains, and remove the uterine stricture, when the opportunity of turning before the discharge of the water which surrounds the infant has been lost. These are blood-letting and opiates in large doses, singly or combined, according to circumstances.

Great gentleness and caution, on the part of the operator, are indispensably requisite to prevent both rupture of the uterus and the subsequent inflammation of the passages. When it is added, that a perseverance for several hours is sometimes necessary for accomplishing this operation, it must be obvious, that it demands in many instances a greater degree of patience, as well as dexterity, on the part of the operator, than most cases of surgery.

The safety of the infant can only be secured, by attending very accurately to the rules for the management of footling cases.

94 Dr Denman, whose discovery of the spontaneous evolution has been already mentioned, at one time supposed that in the cases under consideration, the operation of turning might be dispensed with, and that the patient might be saved much hazard, and the practitioner great anxiety and trouble, by waiting for that change.

But although in the later editions of his valuable work (Introduction to Midwifery), he has relinquished this idea, his observations on the management of preternatural labour of the second order, are evidently influenced by his former opinion.

He says (vol. ii. p. 249.), "Yet the knowledge of this fact, however unquestionably proved, does not free us from the necessity and propriety of turning children presenting with the superior extremities, in every case in which that operation can be performed with safety to the mother, or give us a better chance of saving the child. Under such circumstances, the instructions given by former writers, and the observations we have before made, must still be considered as proper to guide our conduct. But when we are called to a patient with a preternatural labour, in which there is no room to hope for the preservation of the child, or in which we are assured of its death, or when the operation of turning cannot be performed without violence and some danger to the mother, then the knowledge of this probability of a spontaneous evolution, will set our minds at ease, and disengage us from the consideration of making any hasty attempts to perform a hazardous operation, from which no possible good can be derived, except that of extracting a dead child, and which at all events might be effected by a method much more safe to the mother. Preternatural Parturition.

"The time required for the spontaneous evolution of the child, and the facility with which it may be made, will depend upon a variety of circumstances, but chiefly upon the size of the child, the aptitude of its position, the dimensions of the pelvis, and the power exerted by the uterus. If the child be very large or much below the common size, the slower I believe will be the evolution, nor can it be made at all without a strong action of the uterus. It is possible, therefore, when we have conducted ourselves on the ground of expectation that the evolution would be made, that the pains may fall off or be unequal to the effect, and we may be disappointed. It might then be apprehended, that the difficulty of extracting the child would be infinitely increased. But though the evolution was not perfected, I have not found this consequence; for the child, though not expelled, has been brought into such a state that I could afterwards pass my hand with ease, and bring down its feet, though in an attempt to do this at the beginning of the labour I had been foiled. In one case in which the evolution did not take place, I could not bring down the inferior extremities, but I had no difficulty in fixing an instrument upon the curved part of the body of the child, or in bringing it away with entire safety to the mother. It was before presumed that the child was dead, and the sole object was to free the mother from her danger; and with her safety no appearances of the child, however disagreeable, are to be put in competition. In cases of this kind another mode of practice has been recommended, that of separating the head from the body with a blunt hook or other convenient safe instrument; but as I have never practised the method, I give the description of it in a note."

95 There are two points in the above observations, in which it appears that Dr Denman has erred. In the first place, in sanctioning delay in having recourse to the operation of turning where the superior extremity presents. In many such cases, if the pains be not speedily suspended, or the position of the child altered, the uterus would burst; an accident which has repeatedly fallen under the observation of the writer of this article.

The second error is, the supposition that, after it has been found by experience in any given case, that the spontaneous evolution is not to happen, it is easy to extract the child either by the feet or by some instrument. But it will be found in the majority of such cases, that the infant is impacted into so close a body, while the parts are all in a state of swelling and inflammation, that immense difficulty and great danger attend the attempt.

The following observations on this subject cannot be too strongly impressed on the minds of, especially young, practitioners.

"Several

Preternatural Partu-rition.

96

"Several years ago it was discovered by Dr Denman, that in presentations, such as that in the above case, the position of the child is sometimes altered, and its expulsion accomplished, by the natural contractions of the uterus. Although the doctor, with his usual candour, has allowed, that this favourable event, under such alarming circumstances, is rather to be wished than expected; yet he has offered it as his opinion, that if all interference of art were avoided, "the woman would not, in this case, die undelivered."

"The preceding history, however, affords a melancholy contradiction to this opinion. The midwife, who attended from the beginning, did nothing to interrupt the natural process, as far as could be learned. Her fatal error was having only looked on, and having neither given that assistance which was necessary, nor sent for others who could do so.

"The spontaneous evolution, as Dr Denman has called it, can only take place where the child lies in a particular situation, viz. where the action of the uterus cannot be exerted on the presenting part, or where that part is so shaped that it cannot be wedged within the pelvis. A practitioner may, therefore, by a careful examination, be able to decide whether the evolution will happen or not. This observation is by no means a matter of speculation, being, on the contrary, of much practical utility; for, if there be signs which indicate the event alluded to, it follows, as a consequence, not only that the natural process is not to be counteracted, but also, that it is to be assisted. Two cases occurred during one year, where the author of these remarks had an opportunity of prognosticating and assisting the evolution, in presence of two gentlemen then attending the professor of midwifery, as annual pupils.

"That the uterus should continue rigidly contracted on the body of the child, while the strength of the woman was so much exhausted that no pulse could be felt, and that she appeared sinking very fast, is a singular and an instructive fact. It will, it is to be hoped, teach practitioners the fallacy of the assertion, *that the longer the operation of turning is delayed, the more easily it will be accomplished.*

"It may seem astonishing, that the body of the child could not be drawn down with the crotchet, since it was in a state of great putridity. But when it is considered, that the long-continued action of the uterus had wedged it very strongly within the pelvis, while, at the same time, the pressure on the soft parts lining that cavity had swelled them much, the circumstance will be readily understood (N)."

97

Authors have endeavoured to ascertain the causes of preternatural labours; but little satisfaction has been derived from their researches. It is probable, that some cases depend on different causes from others. For example, in some women preternatural labour occurs more than once. Such cases seem to depend on some peculiarity in the uterus or ovum. Again, it is well known to practitioners of midwifery, that, on some occasions, where the child had been found to present naturally at the commencement of labour, the position is perceived to be preternatural after the first stage is completed (O). In these cases the change of position may perhaps be justly attributed to irregularity of action of the uterus. Besides, there can be little doubt that some cases of preternatural labours originate from the premature rupture of the membranes.

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98

2. The bulk of the fœtus also occasions considerable deviations from nature in labour; for it may be either too small or too large.

l. The fœtus, at the full period of gestation, is never of so small size as to occasion any deviation from nature, unless it have been for some time dead. It is indeed, a very remarkable fact, that women often carry to the full time a fœtus which had died about the fifth or sixth month.

In such cases, the child is sometimes expelled so rapidly, the passages opposing little or no resistance, that the uterus is suddenly emptied of its contents; and hence, from the irregularity of its contraction, the placenta is retained, or uterine hæmorrhagy takes place.

99

m. The patient, however, is exposed to more dangers from the increased than the diminished bulk of the fœtus. The fœtus may exceed the ordinary size, either from a natural increase of bulk, or from monstrosity, or from disease.

k k. It has been already stated that the fœtus at the full term of gestation, generally weighs from seven to nine pounds; but on some rare occasions it is found to exceed ten or twelve pounds, or even thirteen. Although, however, the process of delivery is not so rapid where the child is so large, yet if no other circumstance occurs to impede labour, it will be eventually terminated with safety both to mother and child in most cases. Where indeed, under such circumstances, the patient has not formerly had a child, there is always reason to apprehend that the infant may be destroyed by apoplexy, or the mother may be very much bruised. In some cases of this kind, it becomes necessary to open the head of the infant.

l l. When the child is monstrous, from the redundancy of some large parts, as from two heads or two bodies, it is sufficiently obvious that if the mother be at the full term of gestation, the obstacles to delivery will be insurmountable by the natural powers. Fortunately, however, in by far the greatest number of cases of monsters of that kind, the action of the uterus is excited before the ordinary period.

m m. The most frequent disease of children, which proves an obstacle to labour, is the enlargement of the head from hydrocephalus. On some occasions the head is enlarged to an extraordinary size.

100

Sometimes too, the thorax or abdomen is distended and enlarged by a watery fluid. Professor Saxtorph has recorded the following example of an obstacle to delivery from a very uncommon disease. "D. 18. Sept. 1775. in domo obstetricia regia, mox paritura admittebatur gravida. Instante partus principio dolores partus veri debito modo alternantes, sed solita proportione vehementia, duratione et celeriori recursu infligebant. Rite tendebatur

(N) Select Cases in Midwifery, p. 110.

(O) Vide Denman's Introduction, vol. ii. p. 254.

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tendebatur orificium posteriora versus inclinans; justa erant capitis situs, directio et aquarum formatio; pelvis partesque molliores, viam partus constituentes, nullo laborabant vitio; quibus omnibus accessit adhuc sanus et robustus corporis feminei habitus, et partus aliquoties antea perpessi felix eventus, quæ indubie ominabantur incæptum hocce negotium partus feliciter quoque finiendum fore. In progressivo rite procedebat partus.

"In fine vero capite sponte nato, truncus solita facilitate sequi nolebat, quare obstetrix in arte adhuc novitia constitutam domus obstetricem expertem satis sociam sibi advocabat.

"Corpore fœtus ad latus revoluto, ut humeri in majore diametro aperturæ pelvis inferiori minorem facerent resistentiam, brachiisque eductis, junctis viribus truncum ad axin pelvis extrahere moliebantur; attamen obstabat abdomen nulla illarum vi ulterius cedens.

"In auxilium tunc accedens, qui domum isto tempore artem addiscendi gratia habitabat studiosus, manum sub abdomine prudenter intulit, quod tensum atque complanatum sine omni obstaculo inveniebat; ulterius vero manum protrudens pedes tetigit, interque crura tumorem ingentem tensum fluidoque contento plenum reperiebat.

"Compressa hocce tumore, dum adstantes omni vi truncum simul attrahebant, disrumpebatur subito, insignisque aquæ copia effluxit; superato sic obstaculo, facillime extrahebatur fœtus, vitam per biduum trahens.

"Fœtus postea examinatus fœmellus erat, ingentem saccum inter femora gerens, qui ex elongatione integumentorum universalium corporis a tergo versus anteriora ita protractorum, ut orificium ani ex facie anteriorie corporis prope vulvam conspiceretur, ortum habebat. In ipso sacco post effluxionem humoris, aquæ fere lib. iv. capiente, nihil præter hydatides parvas observatu dignum erat. Os sacro vero, ad angulum rectum versus posteriora curvatum caudæ instar prominebat (1)."

101 SECT. III. *Of the Deviations from Natural Labour, which depend on the State of the Passages through which the Child is forced.*

The deviations from natural labour occasioned by the state of the passages, originate either from the soft parts, or the bones.

The obstacles from the soft parts are tumours within the womb, thickening and induration of the neck and month of the womb, enlargement of the ovary, cicatrix in the vagina, collection of fæces within the rectum, swelling of the parts lining the pelvis, malformation and extreme rigidity of the external parts.

It is a curious fact, not only that conception sometimes takes place when there is a tumour within the womb, but also that pregnancy goes on to the full period. When this has happened, the tumour has been pushed down before the infant, and has filled up the passages.

If this obstacle be ascertained at an early period of the labour, which it must be if the practitioner be in any ordinary degree skilful and attentive, the tumour may be pushed back, and the feet of the child may be brought down. In a case of this kind, where the writer of this article was called in after the tumour had become wedged within the pelvis, and the head had been opened, the delivery was accomplished with extreme difficulty, and the poor woman survived only a few hours.

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The following singular case of an excrescence on the os uteri, is stated by Dr Denman, vol. ii. p. 65.

"In June 1770, I was desired to see a patient in the 102
eighth month of her pregnancy, who in the preceding night had a profuse hemorrhage. Her countenance shewed the effects of the great loss of blood she had sustained; and from the representation of the case given me by the gentleman who was first called in, I concluded that the placenta was fixed over the os uteri. On examination I felt a very large fleshy tumour at the extremity of the vagina, representing and nearly equalling in size the placenta, which I judged it to be. Had this been the case, there could not be a doubt of the propriety and necessity of delivering the patient speedily; and with that intention I passed my finger round the tumour, to discover the state of the os uteri. But this I could not find, and on a more accurate examination, I was convinced that this tumour was an excrescence growing from the os uteri, with a very extended and broad basis. I then concluded that the patient was not with child, notwithstanding the distention of the abdomen, but that she laboured under some disease which resembled pregnancy, and that the hemorrhage was the consequence of the disease. A motion which was very evidently perceived when I applied my hand to the abdomen, did not prevail with me to alter this opinion.

"It was of all others a case in which a consultation was desirable, both to decide upon the disease, and the measures which it might be necessary to pursue; and several gentlemen of eminence were called in. That she was actually pregnant, was afterwards proved to the satisfaction of every one; and it was then concluded, that such means should be used as might prevent or lessen the hemorrhage, and that we should wait and see what efforts might be naturally made for accomplishing the delivery.

"No very urgent symptom occurred till the latter end of July, when the hemorrhage returned in a very alarming way, and it was thought necessary that the patient should be delivered. There was not a possibility of extirpating the tumour, and yet it was of such a size, as to prevent the child from being born in any other way than by lessening the head. This was performed; but after many attempts to extract the child, the patient was so exhausted, that it became necessary to leave her to her repose, and very soon after our leaving her, she expired.

"We were permitted to examine the body. There was no appearance of disease in any of the abdominal viscera, or on the external surface of the uterus, which was of its regular form; and when a large oval piece was taken out of the anterior part, the child, which had

(1) Vide Societatis medicæ Haumensis Collectanea, vol. ii. p. 23.

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had no marks of putrefaction, was found in a natural position. An incision was made on each side of the cervix to the vagina, and then a large cauliflower excrescence was found growing to the whole anterior part of the os uteri. The placenta adhered with its whole surface; so that the blood which she had lost must have been wholly discharged from the tumour (M)."

103 In two cases, where a great thickening and induration of the neck and mouth of the womb, approaching to the nature of schirrosity, had taken place previous to conception, the natural action of the uterus, though after a very considerable time indeed, assisted by copious blood-letting, eventually overcame the resistance. One of the patients died ten months after, with all the symptoms of real cancer uteri. The other was restored to perfect health after lying-in.

104 Dr Denman has recorded (vol. ii. p. 73.) two cases, where the enlarged ovarium impeded the progress of the child. In the one case the head of the infant was opened, and the delivery completed by the crotchet; but the patient died at the distance of three weeks. In the other, a trocar was passed into the tumour, and a living child was born. The patient recovered from her lying-in; but died hectic at the end of six months. In such cases, the ovary may be pushed back, if the circumstance be discovered early enough.

105 Cicatrix of the vagina, in consequence of former injury, may appear at first to impede the progress of the infant; but it will always be found to yield to the pains, if the strength of the patient be supported, and proper means be adopted to counteract the effects of the long-continued labour throes. A case occurred some time ago to Dr Hamilton, where a substance, of the hardness of gristle, as thick as an ordinary sized finger placed between the vagina and rectum, and apparently extending from the ramus of one ischium to that of the other, presented an unsurmountable obstacle to the passage of the child. He was called in after an unsuccessful attempt had been made to tear away the infant, and found the woman in a state of extreme danger. He was informed, that five years before that period, she had had a very severe tedious labour, followed by great inflammation and suppuration of the external parts. The indurated part was cut through without the patient making any complaint, and the child was very easily extracted; but she survived the delivery only two days. The relations would not permit the body to be opened.

106 A collection of fæces within the rectum has been known to occasion such resistance to the passage of the child, that the woman has died undelivered. In general, however, it is in the power of an active practitioner to empty the gut at the beginning of labour. But if, from neglect, the head of the child be jammed in the pelvis, and immoveably wedged in consequence of an accumulation of fæces, it then becomes necessary to open the head.

107 Perhaps the most frequent affection of the soft parts which impedes the process of the infant is, swelling of the parts lining the pelvis. This circumstance has been already hinted at. It can never happen where the practitioner is ordinarily attentive; for the tenderness, heat, and dryness of the passages, which precede the actual swelling, cannot be overlooked by one at all aware of the possibility of such an event. When it has actually happened, nothing can save the mother but opening the head of the infant. After this most unpleasant operation is completed, the extraction of the child is seldom a matter of much difficulty.

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108 Malformation of the external parts in some cases does not prevent conception. Two cases have fallen within the knowledge of the writer of this article, where the woman had conceived though the orifice of the vagina had not been capable of permitting the introduction of even the little finger. And it consists with his knowledge, that about thirty years ago a woman under similar circumstances, was brought into the Royal Infirmary of this place, and was delivered by the Cæsarean operation. She died within two days.

It is sufficiently obvious that the safe practice under such circumstances is to enlarge the natural opening, by making an incision in the direction of the perinæum, taking care not to wound the sphincter ani.

109 Extreme rigidity of the external parts is one of the most frequent causes of deviation which depends on the state of the soft parts. It takes place, in a greater or less degree, in the greatest number of women who lie in for the first time; and generally in all women who are considerably advanced in life before they have children.

It is seldom that the resistance opposed by the external parts is so very great as to prove an invincible obstacle to labour. But, on many occasions, the long-continued pressure of the child on those parts produces the most disagreeable consequences, as inflammation of all these parts and of the bladder. Inflammation in those parts is always dangerous, for there seems to be a remarkable tendency to gangrene. Cases are on record where the whole parts have sloughed off, and where the rectum, vagina, and bladder, have formed one canal. Perhaps death is much preferable to life under such circumstances.

Copious blood-letting, and the liberal use of some unctuous application, with time and patience, in general overcome the rigidity of the external parts. Placing the patient over the steams of hot water was formerly recommended in such cases, but this practice is now exploded.

B. Many deviations from natural labour occur from the state of the bones of the pelvis, for they may be so much altered in shape as either to increase or diminish considerably the aperture of that part.

d. When the apertures of the pelvis are too large, the mother incurs much danger, and the child is not totally exempt from hazard.

aa. The danger incurred by the mother arises from there being no resistance to the passage of the child, so that when the action of the uterus begins, the child may be pushed by the force of the pains through the passage before the soft parts be dilated; hence the uterus may be ruptured, or the soft parts lacerated. If,

(M) Were such a case again to occur, there could be doubt respecting the propriety of fixing a ligature round the neck of the tumour.

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on the other hand, the external parts be soft and yielding, a considerable portion of the uterus may be excluded without the parts. There is a very wonderful history of a case of this kind alluded to by Saxtorph in the following words. "Memorabilius adhuc exemplum est illud à cel. Wolfg. Mullnero allatum, ubi *totus uterus* una cum fœtu extra genitalia dilapsus, fœtusque vivus extra pelvim versione extractus fuit, matre post reductionem uteri superstite. Vide ejus *Bahrnehmung von einer samt dem Rinde ausgefallenen Debahrmutter*, *Nurnberg* 1771 (L).

111 *bb.* The hazard which the child undergoes is that of being suddenly expelled, included within the entire ovum, so that it may be lost before proper assistance can be afforded. Another danger is, that the membranes having given way, it may be dashed with violence upon the floor on which the patient walks. Whenever from the great width of the hips, there is reason to suspect that the pelvis is too large, the practitioner should continue in constant attendance from the very commencement of labour, and should carefully adopt the appropriate and obvious means to prevent the hazards just enumerated.

112 *c.* But deficiency of space in the apertures of the pelvis occurs much more frequently than increase. The apertures of the pelvis may be diminished from natural small size or malformation of the bones, from exostosis, or from altered shape in consequence of mollities ossium.

Cases where the sacrum and ilia are of an uncommon small shape are not frequent. Narrowness of the base of the sacrum is sometimes met with; and in a few cases it has been found that the apex of the sacrum has approached too nearly to the anterior part of the pelvis, so as to diminish the apertures at the outlet

113 Exostoses seldom prove an obstacle to delivery; but one exception to this rule fell under the observation of the writer of this article several years ago. The exostosis extended along the whole extent of the symphysis pubis, and was fully as thick as an ordinary sized finger. The woman had been delivered previous to his being called in, but the exhaustion which followed, (for she had been allowed to continue five days and nights in constant hard labour) occasioned her sinking a very short time after delivery. In this instance both mother and child were lost from the self-sufficiency and ignorance of the midwife.

The deficiency may exist in the brim, the outlet, or the cavity singly or combined.

The brim is much more frequently affected by mollities ossium than the outlet; and, as was long ago remarked by Levret, it generally happens, that when the brim is narrowed from this cause, the outlet is widened.

114 The brim may be diminished in size by the projection of the promontory of the sacrum, or by the flattening of the pubes, or by the approximation of the bones where the pubes and ilia unite, or by a combination of some of these circumstances. The projection of the promontory of the sacrum, however, is by far the most common. When this happens, the projection sometimes renders one side of the pelvis wider than the other, and this constitutes what authors call the distorted pelvis. Sometimes, however, it leaves both sides of an equal width, and this is called the deformed pelvis.

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The deficiency in the brim produced by these causes is very various; most frequently slight, but sometimes so great that there is not an inch between pubes and sacrum.

115 The outlet may be diminished by the approximation of the tuberosities and rami of the ischia, or by the apex of the sacrum and coccyx projecting more than usually forward, while they are at the same time hooked up.

116 When both the brim and outlet are diminished in aperture, the cavity of the pelvis is generally affected also; but when the deficiency of space is confined to either, the cavity is commonly more shallow than natural, by which both the resistance and the danger are considerably lessened. Melancholy are the cases where the cavity is rendered deeper than usual.

As the practice in cases of extreme deficiency in the apertures of the pelvis is to be regulated by the degree of narrowness, it is a matter of the first importance to be able to ascertain the dimensions in any given case with tolerable precision.

117 For this purpose, instruments called pelvimetres have been invented. M. Coutuoli has proposed one for internal use, and M. Baudelocque has recommended one for external application. But however plausible in theory the use of such contrivances may appear, it is now well known that no dependence can be placed upon them in actual practice, and therefore the hand of the operator must be had recourse to for determining both the shape and the extent of the apertures of the pelvis, wherever there is any narrowness. The following directions for this purpose given by Dr Wallace Johnson are extremely judicious.

118 "On passing the finger along the vagina, if the coccyx, or any part of the sacrum, be felt unusually forwards or near at hand; or if the symphysis, or any other part of the pubes, is found projecting rather inwards than outwards, it is evident that the pelvis is distorted. In which case, as well as in those where it is not distorted, but only very small, the principal part of the child's head (allowing the presentation right) remains high, the vertex making only a little round tumor within the brim: so that when the os uteri is opened, and come a little forwards towards the pubes, the capacity of the pelvis may be found out by moving the end of the finger round that part of the head which has entered the upper strait. This method is used by several practitioners in London. However, should the finger not be long enough to effect it properly, as sometimes is the case, there is then another method, which, being more certain, may be used, provided it be done with tenderness and caution, and when the orifices are so well opened as to admit of it with safety. But previous to it, the operator must be well acquainted with the dimensions of his own hand, viz.

"First,

(L) Dissertatio Inauguralis de Diverso Partu, &c. Auctore Matth. Saxtorph, p. 46.

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"First, The fingers of a middle-sized hand (as we may suppose the operator's to be) being gathered together equally into the palm, and the thumb extended and applied closely along the second or middle joint of the finger; the distance between the end of the thumb, and outer edge of the middle joint of the little finger, is usually four inches.

"Secondly, Whilst they are in the above position, the distance from the thumb, at the root of the nail, in a straight line to the outside of the middle joint of the little finger, is full three inches and a half.

"Thirdly, the fingers being still in the same situation, and the thumb laid obliquely along the joints next the nails of the first two fingers, and bent down upon them; the distance between the outside of the middle joint of the fore finger, and the outside of that of the little finger is three inches and a quarter.

"Fourthly, The hand being opened, and the tops of the four fingers being a little bent, so as to come nearly in a straight line; their whole breadth, across the joint next the nails, is two inches and a half.

"Fifthly, when the first three fingers are thus bent, their breadth across the same joint is two inches.

"Sixthly, The breadth of the first two, across the nail of the first finger, is one inch and a quarter.

"And, seventhly, The fingers being gathered into a conical form, the thumb lying obliquely upon the palm of the hand, with its point upon the first joint of the ring finger, reckoning downwards, will measure in thickness, between its back and the fore part of the thumb, two inches and two-eighths.

"Now, as hands are extremely various, the operator ought always to know how much the size of his differeth from the above dimensions; and this being rightly understood, the application may be made as follows:

"The patient, being in the position as for natural delivery, and the operator's left hand being well anointed, and the fingers and thumb gathered into a cone, it must be gently passed into the vagina, and then through the os uteri, unless in this part there is still a rigidity to forbid it; if so, the fingers only must be passed, their extremities formed into the fourth dimension, and then placed edgeways in the strait; which being done, if the fore finger touch the angle of the sacrum, and the little one the symphysis of the pubes, the width is then manifestly no more than two inches and a half; a space through which a mature child can neither pass alive, nor be brought so by art, unless it happens to be preternaturally small indeed."

Three methods of practice have been adopted in cases of such narrowness of the pelvis as renders it impossible for the child to be protruded alive, viz. the operation of embryulcia or embryotomy, the Cæsarean section, and the division of the symphysis pubis.

119 I. *Embryotomy.* The cases requiring this most shocking operation are those where the infant cannot be extracted alive through the natural passages; while there is, nevertheless, such space that it may be torn away piece-meal without injury to the mother. Of course, in these cases the life of the woman can be saved only at the expence of her infant.

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But although authors and practitioners in modern times adopt in general this principle, they differ materially in their account of the precise cases requiring the operation.

Dr Osborn alleges, that, as the head of the infant at the full time of utero-gestation cannot be diminished to less than three inches between the parietal protuberances by the natural contractions of the uterus forcing it against the bones of the pelvis; wherever the aperture at the brim or outlet falls under three inches, the operator ought to proceed as soon as possible to open the head of the infant.

But on so very serious an operation as that by which one life is destroyed, it becomes a practitioner to adopt no rule which can be at all liable to error; and it is evident, that there are three very strong objections to this precept of Dr Osborn.

First, It is impossible in any case at the beginning of labour, to ascertain that the infant is at the full term of utero-gestation; but it is well known, that a child at the age of between seven and eight months, if born alive, may be reared to maturity, and that such a child is capable of being expelled without injury, through an aperture incapable of permitting the passage of a full-grown fœtus.

Secondly, The heads of children, even at the full time, are sometimes so small and so yielding as to admit readily of their short diameter being diminished below three inches.

Thirdly, every candid practitioner must allow, that it is quite impossible to ascertain with geometrical accuracy the precise dimensions of the pelvis; and consequently what in any given case may appear to the operator to be less than three inches, may in fact be above these dimensions.

For these reasons, wherever the narrowness is not obviously very considerable, the prudent rule is to ascertain the effect of the labour-throes, supporting the strength of the patient, and palliating distressing symptoms. By adopting this rule, the practitioner will not only have the consciousness of not having destroyed life unnecessarily, where he is eventually forced to open the head, by the conviction that it is too large to pass unopened, but also the innate satisfaction of sometimes saving a life, which under less cautious management must have been sacrificed. Great care indeed is necessary in such cases not to be deceived in the estimate of the progress of the child, for the swelling of the scalp may mislead a young practitioner.

There has been a variety of opinion too, respecting the lowest dimensions of the pelvis which permit the operation of embryulcia with safety to the mother; and it is surely unnecessary to state, that unless there be a moral probability of saving the life of the mother by this operation, it ought never to be had recourse to.

Dr Kellie, of London (P), and Dr Osborn (Q), have recorded some cases where this operation was performed, although

(P) Dr Wallace Johnson.
(Q) Dr Osborn's Essays.

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although the narrowness was very great; and the latter gentleman, founding on a single case, assumes the principle, that whenever there is a space equal to an inch and a half between pubes and sacrum, the operation of embryulcia is practicable. But a careful perusal of the case alluded to (A) must satisfy any unprejudiced person that there must have been some mistake, most probably, from the swelling of the soft parts lining the pelvis having added to the apparent narrowness, and having, after the head had been opened above 36 hours, subsided. And at any rate, since experience has now fully established the fact, that the danger resulting from this operation is always in proportion to the degree of resistance, it may be concluded that the operation of embryulcia cannot prove safe to the mother, unless, first, there be an aperture equal to about two inches by four; and, secondly, the narrowness be chiefly, if not altogether, confined either to the brim or the outlet. When both brim and outlet are deficient, and the cavity is deeper than usual, even although the several apertures be quite sufficient to allow the diminished head to be extracted, the injury that must accrue from the violent pressure on all the parts within the pelvis would deter any prudent practitioner from hazarding such an operation.

When it is determined to have recourse to the operation of embryotomy, the instruments required are the perforator, the crotchet, and the embryotomy forceps delineated in the plate.

122 The operation is to consist of two different processes; first, the diminution of the head; and, secondly, the extraction of the mangled child. In many cases the latter should be performed immediately after the former is accomplished; but whenever the resistance is very considerable, an interval should be interposed between the two. The advantages resulting from this practice were first publicly noticed by Dr Osborn, though there can be little doubt that the practice itself was the effect of necessity. By waiting after the head has been opened, the woman's strength will be restored, so that the assistance of the pains in the expulsion of the child may be obtained; the swelling of the soft parts will subside, by which the resistance may be greatly lessened, as well as the danger of inflammation removed, and the child's body will become putrid, by which its extraction may be greatly facilitated.

123 In opening the head, which is to be done by means of the perforator, the two great points to be aimed at are to avoid injuring any part of the woman, and to make a sufficiently large opening of the head. On the complete accomplishment of the latter, the eventual success of the operation must depend in all cases of extreme deficiency of space.

Should it be found expedient to delay the extraction of the infant after the head has been opened and its contents evacuated, the teguments are to be carefully brought over the ragged edges of the bones, so that in the event of labour throes recurring, there shall be no risk of the parts within the pelvis being injured.

When it has been found proper to proceed to the extraction of the infant, the first thing to be attempted is to diminish the bulk of the cranium as much as possible. This may be done by means of the embryulcia forceps, delineated in the plates, and contrived it is believed by Dr Lyon of Liverpool. It is an instrument far superior to the almisdach of the Arabians, in use even within these fifty years among the practitioners of this island (B). Preternatural Parturition.

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After the head has been sufficiently reduced in bulk, the crotchet is to be fixed at first on the inside of the cranium; and while two fingers of the left hand are to be kept constantly so applied that if the instrument should slip in the process of extraction, it shall be received on the fingers, and cannot possibly touch any part of the mother, the operator is to draw down with a suitable exertion of force, in such a direction that the largest part of the head shall be brought through the widest part of the pelvis.

In some cases, much time and very violent exertions are required to accomplish the delivery; but, if the proper precautions to prevent any injury to the passages be adopted, and if at the same time the operator imitate nature by working only from time to time, and increase the force employed gradually as may be required, and persevere patiently, notwithstanding the resistance, taking care to support by nourishment and cordials the strength of the woman, the delivery at last will be completed.

125 The dangers to be dreaded from this most shocking operation, are injuries of the passages, from the instrument's slipping through the embarrassment of the practitioner; or violent inflammation of all the contents of the pelvis extending to the abdomen, in consequence of the parts through which the child must be so forcibly extracted being severely bruised. Accordingly, a greater number of women die from the effects of this operation than practitioners are willing to admit; and indeed, in every case of extreme deficiency of space, where embryotomy is performed, the recovery is to be regarded as doubtful.

This operation is sometimes had recourse to in cases where the forceps should have been used had the child been alive. But such cases are very rare, because the evidence of the infant in utero being dead, is seldom so complete as to justify the practitioner proceeding on the principle that it is so.

II. By the *Cæsarean section* is meant the extraction 126 of the infant through the parietes of the abdomen by an incision into the uterus.

This bold operation was perhaps never performed by the ancients on the living subject, and certainly was first recommended to practitioners by M. Rousset in his *Traité nouvelle de l'Hysterotomie*, &c. 1581. Since that time it has been often performed on the continent, and about twenty times in Great Britain. The success of this operation recorded in the early works has certainly been exaggerated; but it appears by an elaborate memoir by M. Baudelocque, translated into English by

(A) Osborn's Essay, p. 240.

(B) For an account of the ancient instruments employed in the practice of midwifery, see Sculteti Armament. Chir.

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by Dr Hull of Manchester, that during the 50 years preceding 1802, the operation has been had recourse to on the continent 95 times, and that 37 of these cases proved successful. In Great Britain, on the contrary, this operation has never yet succeeded, a circumstance to be attributed partly to the delay which has always taken place after the necessity for such an expedient had been determined, and hence the patient, at the time the operation was performed, must have been in a state of exhaustion; and partly, perhaps chiefly, to the previous very alarming state of health of the subjects of the operation in this island. It is at any rate certain that all over the continent practitioners have less horror at performing the Cæsarean section than British practitioners have commonly shewn; and it is deemed necessary in cases where the operation of embryulcia is preferred in this country, and where of course the women are not in such a precarious state of health as those commonly are who have extreme narrowness of the pelvis.

127 In consequence of the fatality of the Cæsarean section in Great Britain, several eminent practitioners have regarded it as unjustifiable. Dr Osborn has rendered himself particularly conspicuous on this subject, and uses very strong language in reprobation of it. His arguments are, its acknowledged fatality; the capability of completing the delivery by means of the crotchet, in cases of such deformity of the pelvis, that there is no more than one and a half inch between the pubis and sacrum, or to one side of the projecting sacrum; and the impossibility of impregnation taking place in cases of greater deficiency of space. We shall notice these arguments in their turn.

128 1st, *The acknowledged fatality of the operation.*—This relates only to the result of the operation in Great Britain; for, as already mentioned, a great proportion of the patients has been saved on the continent. But in insisting on this argument Dr Osborn has overlooked that the object of the operation is to save, if possible, two lives, and at any rate one. Now if it can be satisfactorily proved, that on some occasions the operation of embryotomy is absolutely impracticable, it becomes the duty of the practitioner to save one life at least; and it is well known that the Cæsarean operation is far less painful to the woman than that of embryotomy, even where that latter operation is eventually successful. In such cases of extreme deformity, either an attempt should be made to deliver the woman and save the child, or both must be allowed to perish; for the operation of embryotomy, if attempted, must be regarded as wilful murder.

129 2dly, The *practicability* of tearing away the child in pieces by means of the perforation and crotchet, in cases where there is no more than an inch and a half between the pubis and sacrum, or to one side of the projecting sacrum, is alleged by the doctor on the foundation of a single case, that of Elizabeth Sherwood already referred to. But any person who shall take the trouble to have the aperture of Sherwood's pelvis, as stated by Dr Osborn, cut out in wood, and to compare this with the basis of an infant's skull as much diminished as possible by the crotchet (which is done in the course of his lectures by the professor of midwifery in this university), must be convinced, that there was some mistake in the supposed dimensions of that woman's pelvis. And it is quite obvious, that unless there be the space already stated, viz. three and a half or four inches by two, it is unsafe to extract the mangled child through the natural passages.

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130 3dly, The *allegation* that where there is a greater degree of narrowness of the pelvis than that which was supposed to have happened in the case of Sherwood, impregnation cannot take place, is quite inconsistent with facts. One of the most remarkable cases of extreme deformity is that of Elizabeth Thompson, on whom the Cæsarean operation was performed at Manchester in 1802. The description as given by Dr Hull (G) is as follows: "The pelvis of this patient was not nearly so soft as has sometimes been observed. It still had a considerable degree of bony firmness. The ossa innominata at their sacro-iliac synchondroses, and at the symphysis pubis, before the pelvis was dried, admitted of a slight degree of motion.—The distance from the crista of one os ilium to the other, at their most remote points, measures ten inches and a half.

"The alæ of both ossa ilia are very much bent; and on the left side the curvature is so great, that it measures only two inches from the anterior and inferior spinous process to the opposite posterior point. The lumbar vertebræ project forwards or inwards, and make a considerable curve to the left side of the pelvis. The distance from the lower part of the second lumbar vertebra to the anterior part of the spine of the os ilium, on the left side, is two inches. The distance from the lowest part of the second lumbar vertebra to the anterior part of the spine of the os ilium, on the right side, is five inches.

131 "*Superior aperture.* The conjugate or antero-posterior diameter, from the symphysis pubis to the upper edge of the last lumbar vertebra is one inch and a half.—This diameter is not taken from the os sacrum, or its junction with the last lumbar vertebra, because the point of their junction is so much sunk into the pelvis, that the place it should have occupied, is represented by the junction of the fourth and fifth lumbar vertebra. The tranverse diameter measures four inches and five-eighths. It is taken from one sacro-iliac symphysis to the other. The distance of the point of this aperture, which is opposite to the anterior part of the right acetabulum, from the lumbar vertebra, is only half an inch. The distance from that part of this aperture, which corresponds with the posterior part of the right acetabulum, to the os sacrum, is three-fourths of an inch. The distance of the point, corresponding with the anterior part of the left acetabulum, from the lumbar vertebra, is five-eighths of an inch. The distance of the point of this aperture, opposite to the posterior part of the left acetabulum, from the os sacrum, is three-fourths of an inch. The distance of one os pubis from the other, in the points marked in the plate, is seven-eighths of an inch. The distance from the right sacro-iliac symphysis to the symphysis pubis is three inches and three-fourths. The distance

(G) Observations on Mr Simmons's Detection, &c. p. 195.

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stance from the right sacro-iliac symphysis to the left os pubis is three inches and three-eighths. The distance from the left sacro-iliac symphysis to the symphysis pubis is three inches and five-eighths. The distance from the left sacro-iliac symphysis to the right os pubis is three inches and one-fourth. The largest circle, that can be formed in any part of the superior aperture, does not exceed in diameter one inch.

132 "*Inferior aperture.* The distance from one ramus ossis ischii to the other, where they are united with the rami ossium pubis, measures only half an inch. The distance from the tuberosity of one os ischium to the other measures one inch and two-tenths. The conjugate or antero-posterior diameter, taken from the symphysis pubis to the point of the os coccygis is three inches.

"The angle, included by the rami of the ossa pubis, is very acute, viz. an angle of about 20 degrees. The perpendicular height from the tubera of the ossa ischia to the inferior margin of the symphysis pubis is two inches and a half. The perpendicular height of the symphysis pubis is one inch and a half. The tuberosity of the left os ischium advances forwards, beyond that of the right, about six-tenths of an inch, and the whole of the rami ossis pubis and ischii on the left side projects beyond those of the right. The perpendicular height of the os sacrum and coccyx is two inches and one-fourth only, the os sacrum being bent so as to form a very acute angle. The acetabula, at their nearest points, are only three inches distant. The symphysis pubis is much more prominent than natural. The upper margin of the symphysis pubis is situated as high as the bottom of the fourth lumbar vertebra."

It appears then that Dr Osborn's arguments are fallacious, and that cases occur where the operation of embryotomy is neither safe nor practicable. Under such circumstances, the Cæsarean section must be had recourse to; and it is therefore to be regarded as an operation of necessity, not one of choice. If this rule be adopted, the cases requiring so formidable an expedient will happily be very seldom met with.

133 Mr Simmons of Manchester, observing that Dr Osborn's third argument is untenable, has proposed in the following words, another substitute for the Cæsarean operation.

"When a case shall arise in which the child cannot be delivered by the crochet, from the brim of the pelvis being no more than one inch in diameter I propose to combine the two operations, and to divide the symphysis pubis to make way for the crotchet. Dr Osborn has urged several objections against this proposal, although he admits that the operation at the symphysis is not so certainly fatal as the Cæsarean section. Weighty objections doubtless press against it; but while there are no other means for preserving life, bad as the chance is, it becomes a question whether it be worth risking; and, after maturely considering the case, should an attempt for saving the life of the mother be judged expedient, as the last resource it may be adopted.

"The space gained has been differently stated at from three to eight or nine lines in the diameter;—the medium distance would probably be sufficient to accomplish the delivery by the crotchet.

"The objections urged against this mode of delivery, when the head is of the full size, will not apply to its reduced bulk; and it should be remembered, that the symphysis is formed of cartilage and ligament; so that whatever pressure shall be made against the divided edges, will not be made against the sharp angles of bone. That much injury may be done anteriorly will not be denied; but does the continued pressure of the child's head never produce mischief in other cases? By the introduction of a female sound for a guide, a cautious and steady operator will avoid wounding the urethra; and, as the base of the skull will probably be turned sideways, it will suffer less in extraction than in other cases of the crotchet; in which it must in general be injured from pressure against the pubis. If the separation, however, be carried beyond a certain length, laceration will probably ensue; and, should this accident occur, I see no reason to apprehend more danger from it than follows the extraction of a large stone from the bladder through a small opening, which will induce a lacerated wound, but which we know will not uncommonly heal. The sacro-iliac ligaments would certainly not be injured by choice, but the consequences, I believe, are not generally fatal; and, should it be urged that great pain and lameness will afflict the patient for a long time after, a reply will readily occur, that life was at stake; and surely there are few who would not compound, for the prospect of temporary pain and inconvenience, to have it preserved to them.

"A spontaneous separation sometimes occurs, both there and at the pubis; and yet the patient has been again restored to health.

"I do not see, in other respects, in what this compound operation differs from the most difficult crotchet case—the Cæsarean section is certainly fatal to the mother in this country—the life of the child, it is agreed, shall not be put in competition with the parent's life—the section of the symphysis is neither so formidable nor so fatal as the Cæsarean section—and the crochet has been successfully applied in dimensions which will probably be thus acquired.

"Upon the whole, then, in that supposed case of distortion (which I hope will never happen) in which the mother must be doomed to death, from the impossibility of delivering the child by the crotchet, the compound operation I have recommended will furnish a resource, approved by reason and sanctioned by experience; inasmuch as the section of the symphysis pubis has been made, and the crotchet has been used, though separately, yet with safety. Such a case will be attended, unquestionably, with additional hazard; but it offers the only chance to the mother, to the preservation of whose life our chief care should be directed: and I hope that in future all trace of the Cæsarean operation will be banished from professional books; for it can never be justifiable during the parent's life, and stands recorded only to disgrace the art."

134 He himself has afforded the most satisfactory evidence of the absurdity of his own proposal; for he had not published it many months when the very case he had described as ideal actually occurred in his neighbourhood, and he had the opportunity of making the experiment of his own plan. But he shrunk from it, and no wonder; for the woman was Elizabeth Thompson, whose pelvis has just been described. It is unfortunate that Mr Simmons has not had the candour to confess his error, and to retract his opinions, more especially since his re-

flections

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135 flections against the Cæsarean operation, were couched in language peculiarly bitter and invective.

With respect to the mode of performing the Cæsarean section, there has been considerable variety of opinion. On theoretical principles, the external incision, viz. that through the parietes abdominis, ought to be in the direction of the linea alba, because there is less chance of any considerable retraction of muscular fibres, or of interfering with the intestines, than if it were made in any other direction. But the result of the practice seems at variance with the theory. According to the testimony of Baudelocque, of 35 operations, where the incision was made on the side of the abdomen, eighteen proved successful; of thirty in the direction of the linea alba, ten only succeeded; and of eight in the manner recommended by Lauverjat, that is, by a transverse incision between the recti muscles and spina dorsi, three succeeded. But it may be remarked, that the event, in many of those cases, may have been influenced by a variety of circumstances, totally independent of the line of direction of the external incision.

In whatever part of the abdomen the external incision be made, it ought to be extended to six inches; and, previous to cutting into the uterus, any active arterial branch, which may have been divided, must be secured; and the liquor amnii, if not already discharged, must be drawn off. The opening into the uterus need not be above five inches in length, and should be made as much towards the fundus as possible. Means are to be employed to prevent the protrusion of the intestines at the time the uterus is emptied. Both fœtus and secundines are to be quickly extracted; after which, the hand is to be passed into the uterus, to clear out any coagula which may have formed within its cavity, to prevent the os tincæ being plugged up, and, at the same time, to promote the contraction of the uterus. The wound in the uterus is to be left to nature; but that of the parietes of the abdomen is to be carefully closed by means of the interrupted suture and adhesive straps; and the whole belly is to be properly supported by a suitable bandage or waistcoat. In the after treatment of the patient, the great objects to be held in view, are to support the strength and moderate the degree of local inflammation.

136 III. *Division of the symphysis pubis.*—This was originally proposed and performed by M. Sigault of Paris. His proposal was made in 1768; but he had no opportunity of making the actual experiment till September 1777.—The success of his first case was such, that a medal was struck to commemorate the event; and the operation was admired and recommended, with all the extravagance of French enthusiasm.

The operation consists of the division of the symphysis pubis and separation of the innominata. For this purpose, a catheter is to be introduced into the urethra, and, with a common scalpel, the articulation is to be cut through from the upper edge of the symphysis, to within a quarter of an inch of the inferior edge. By separating the thighs, the divided bones are forced asunder. After this, the operator is either to turn the child, or to extract it by the forceps, according to the circumstances of the case. Preternatural Parturition.

This expedient was proposed as a substitute, both for the operation of embryulcia, and for the Cæsarean section, as it was alleged to be perfectly consistent with the safety both of mother and child.

It is quite unnecessary for us to offer any theoretical objections to this operation, because we can now reason on the event of thirty-six cases, which have been published.—But those who may wish to investigate this subject, may consult Baudelocque, par 1994. and 2091. inclusive; and Dr Osborn, p. 271. To that latter practitioner's professional zeal and ability is chiefly to be ascribed the total rejection of this operation in Great Britain.

Of the thirty-five subjects of the published cases (for 137 in one woman it was performed twice), fourteen women and eighteen children died.—Of the twenty-one women who survived, nine had either had living children before the Sigaultian operation, or had such at a subsequent period. Most of the remainder suffered much from the operation. Some had incurable incontinence of urine, others lameness, &c. But the most important fact is, that whenever the bones of the pelvis were separated from each other above an inch (and no space of any consequence could be added to the brim, unless they were so), the sacro-iliac synchondroses were torn, and no woman survived that accident.

These facts have at last convinced foreign practitioners of the futility of this expedient; and, accordingly, for above ten years, it has not been performed on the continent by any practitioners of respectability.

When a woman, with a narrow pelvis, who has had 138 the good fortune to recover after the operation of embryotomy, again falls with child, she should not incur the hazard of a repetition of so horrible an operation; but ought to have premature labour induced between the seventh and the eighth month. Under the direction of an intelligent practitioner this operation is easily performed; and, while it affords the only chance of saving the infant, which it is the duty of the mother and of the practitioner to attempt, it at the same time, by lessening the resistance, diminishes both the suffering and the risk of the patient (x).

For a further account of the practice in cases of extreme deformity of the pelvis, the reader is referred to Osborn's Essays; Hamilton's Letters to Osborn; Simmons's Reflections, and Hull's Detection of Simmons.

Sect. IV. *Of the Deviations from Natural Labour which happen from anomalous circumstances.* 139

Certain circumstances besides those already enumerated occasion deviations in the process of labour. Some of these respect the child, and others the woman.

a. The child's life is endangered if the navel-string 140 be so strongly convoluted round its neck, that after the head is born the remainder cannot be expelled without the cord being drawn so tight as to interrupt the circulation through it. Dr Denman, vol. ii. p. 16. has stated this as a cause of protracted labour, and has advised

(x) See a paper on this subject, in the 18th volume of the Medical Facts and Observations, by Mr Barlow.

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vised certain modes of practice in consequence. But if there be pains, there cannot be any material protraction of the labour from this cause.

All risk of the infant may be prevented by slackening the cord, and waiting for the action of the uterus, if the operator find that he cannot draw the loop of cord which surrounds the child's neck easily over its head. But this in most cases can be readily done.

141 *b.* The cord is sometimes pushed down before the presenting part of the child.

If this happen before the membranes are burst, the only certain method of saving the child is to perform the operation of turning as soon as the state of the passages will permit.

When the cord is pushed down along with some other part, as the head, after the waters are discharged, a variety of practice is required according to the circumstances of the particular case; hence merely keeping the cord for a little time beyond the presenting part by means of the fingers, or wrapping it up in a piece of soft rag, and pushing it above the presenting point, or the application of the forceps, are severally found useful in different cases.

142 *c.* Sometimes one or both arms of the child are forced down along with the head, where proper assistance is not had at the beginning of labour. If the pelvis be roomy, and the woman have formerly had children, the delivery may be at last completed by the natural powers, notwithstanding this increased degree of resistance. But in many cases of this kind an experienced practitioner is not called in till the strength of the woman be very much exhausted, and then it becomes necessary to use the forceps, or even on some occasions to have recourse to the operation of embryulcia.

143 *d.* It is well known, that sometimes there is more than one child in the womb. Instances where there are twins are not unfrequent; cases of triplets are alleged to happen once in between three or four thousand births; four at a birth have not occurred in this city for the last twenty-seven years; and there are only two, or at most three, well-authenticated cases of five at a birth having happened within a hundred years in this island.

All the signs by which the existence of more than one child in utero can be ascertained, previous to the actual commencement of labour, are fallacious; and in general it is not till after the birth of one child that it can be determined that another remains in the womb; and, unless under very particular circumstances, it is of no importance. The circumstances alluded to are where different parts of both children are forced into the passage at the same time. Of this a very remarkable case is recorded in the book of Genesis, verse 27. chap. xxxviii.

When the womb appears to remain bulky and hard after the birth of one child, there is reason to suppose that it contains a second. But if there be any doubt on the subject, the practitioner has it in his power to ascertain the point by examination. When there is no second child in the uterus, the further the fingers are carried up within the passages, the more contracted do they feel; whereas, if there be a second child, the more open are they found.

144 When it is ascertained that another infant remains, the woman's belly should be immediately compressed by means of a roller, in order to prevent faintishness from the sudden relaxation of the parietes abdominis, and the portion of the navel-string remaining attached to the after-birth of the first born should be carefully secured, let the vessels of the placenta anastomose.

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In regard to the subsequent treatment, there has been much variety of opinion among practitioners. Some have proposed waiting till the action of the uterus expel the second as it had done the first infant. Others urge strongly the necessity for immediate delivery. 145

Against the former of these practices it is to be objected; first, that in some cases, days or even weeks have been known to intervene between the birth of one child and the action of the uterus which expelled the second. Secondly, that if this happen, the passages must become contracted and their subsequent dilatation may be productive of inflammatory symptoms. Thirdly, that during the time the uterine action is suspended, internal hæmorrhagy may take place, and may destroy the patient. And, fourthly, the second child may be suddenly forced down in such a position, as may endanger its life, and at the same time occasion great pain to the mother.

For these reasons it is now an established rule among judicious practitioners, to examine the situation of the second infant, as soon as the patient shall have recovered from the shock of the birth of the first child; and, if its position be natural and the patient have not been exhausted by the previous labour, and pains come on, to rupture the membranes, and allow the natural powers to complete the delivery. But if the infant present any other part than the head, or though the head do present, if the woman be exhausted, or if there be no appearance of the return of pains within an hour after the birth of the first, then the hand is to be passed up to bring down the feet of the second child, and the delivery is to be expedited. The extraction of the placentæ is to be conducted with great care, and every possible precaution is to be adopted against the occurrence of flooding, which is always to be dreaded as the consequence of plurality of children.

The same principles apply to the management of triplets, &c.

d. Umbilical hernia, to which women are perhaps more subject than to any other species of rupture, may influence the labour materially. 146

If it be reducible, it disappears after the fifth month of pregnancy; but immediately after the expulsion of the child it returns, and occasions frightful faintings and floodings. This may be prevented by the simple expedient of having the belly compressed by a roller in such a manner, that in proportion as the infant advances, the compression may be increased.

Should it be irreducible, if the hernia be affected by the continuance of labour, as may be known by the colour, &c. the operation of turning must be had recourse to.

e. Convulsions sometimes happen during labour, and occasion great danger both to the mother and the child. The woman is quite insensible during the fit, which consists of violent convulsions of the muscles which move the body, and of those of the eyes, the face, and the lower jaw; it lasts in some cases only a few seconds, 147

and

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and in others for several minutes. After the fit has ceased, it sometimes happens that the patient remains in a comatose state; in other cases the sensibility returns.

The circumstances which distinguish this disease from epilepsy were first stated explicitly by Dr Hamilton in the following words: "The old distinction between eclampsia and epilepsia has been rejected by Dr Cullen, without sufficient reason. The convulsions that occur during pregnancy and labour, should be distinguished by the former name, for the disease is always an acute one, and it never, as far as my experience goes, lays the foundation for habitual epilepsy. To an inattentive practitioner, indeed, the phenomena appear similar to those of epilepsy; but, independent of its violence and fatality, there are many circumstances peculiar to it. This has been remarked by several authors, particularly Dr Denman; but those circumstances have never been accurately pointed out in any publication which has fallen into my hands.

Dr Duncan's Annals, vol. v. p. 319.

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"The eclampsia, peculiar to pregnancy and labour, differs from epilepsy in the following respects.

"1. The symptoms which precede the attack are well marked, announcing to an experienced practitioner the approach of the disease.

"2. If the first fit do not prove fatal, and if no means of cure be attempted, it is within a few hours followed by other paroxyms, provided delivery do not take place.

"3. After the paroxysms, even where they have been very severe, the patient in many cases continues quite sensible during the intervals, and the sensibility returns the moment the fit is off.

"4. What may appear still more extraordinary is, that in some cases there is a remarkably increased susceptibility of impression of the external senses; and this supersensation is not confined to patients in whom the convulsions are slight.

"The aura epileptica never occurs in the cases alluded to.

"6. The pulse is, in every case, affected in some degree during the remissions of the fits. It is slow, or oppressed, or intermitting, or frequent and rapid. But it is most commonly slow and oppressed, becoming fuller and more frequent after blood-letting.

149

The symptoms above hinted at as preceding the fits are, violent headach, or sudden delirium, or violent tremors during the second stage of labour. Impaired or depraved vision commonly prove the immediate harbingers of the fit. The event of this occurrence is always precarious, for a single fit may destroy the patient. Death happens in such cases in two ways, viz. either by rupture of some of the vessels within the head, or by the rupture of the womb itself.

150

The cause of the disease is evidently an overload in the vessels within the cranium, and this may be occasioned from a variety of causes, as violent labour throes, passions of the mind, irritations in the prime viæ, &c.

151

In cases of so very alarming a nature, it is not wonderful that practitioners have differed much respecting the practice to be adopted. The following is what has been recommended by Dr Hamilton in the volume of Dr Duncan's annals already referred to.

"When fits have actually occurred during the latter months of pregnancy, the first remedy to be employed, after having adopted the suitable means for protecting the tongue, is blood-letting, both general and topical. Opening the external jugular might answer both purposes, but the restlessness of the patient in many cases makes the surgeon or attendants dread this operation. A quantity of blood, therefore, adapted to the exigency of the case, is to be drawn from the arm, and either a branch of the temporal artery is to be divided, or several leeches are to be applied to the temples. After the bleeding, a powerful laxative glyster ought to be exhibited. And if there be any evidence of disordered primæ viæ, an emetic must, if possible, be given. The state of the os uteri is then to be ascertained; and if labour have not commenced, no attempts whatever are to be made to promote that process. In some rare cases however, where the bulk of the gravid uterus is enormous, it may be necessary to remove a part of its contents; but such cases cannot happen once in a thousand instances of the disease.

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"Should the fits still continue, the head must be shaved, and covered with a large blister; and if the oppression or fulness, or hardness of the pulse, be not removed, the blood-letting is to be repeated.

"As soon as the patient becomes capable of swallowing, the camphor, in doses of ten grains, ought to be given every three or four hours. The most efficacious and palatable form in which this medicine can be prescribed, is by suspending it in boiling water, through the medium of alcohol, sugar and magnesia. Its use must be persevered in for several days, gradually lessening the number of doses.

"Where the eclampsia has been preceded by œdema, the digitalis may be employed with much success.

"Convulsions during labour are to be treated upon the same principles, with these additional precautions, that delivery is to be accomplished by the most expeditious possible means, and that if the delivery be followed by uterine hæmorrhagy, the discharge is for some time to be rather encouraged than checked. I knew two instances of the fits, which had been suspended for some hours, recurring, in consequence of the flooding being stopped, and in both cases the convulsions were removed, by allowing the discharge to return.

"When the symptoms that precede eclampsia, take place in the latter months of pregnancy, the most certain method of guarding against the threatening accident is, having recourse to immediate blood-letting, and afterwards prescribing camphor, attention to the state of the bowels, and a spare diet.

"When the same symptoms occur during labour, a copious bleeding should be instantly ordered, and the appropriate means of terminating the delivery should be adopted with as much expedition as may be consistent with the safety both of mother and child.

"In these concise practical suggestions, practitioners will observe circumstances omitted, which have been recommended by gentlemen of deserved professional eminence, and novelties of practice proposed, which I believe have not hitherto been explicitly advised. Some explanation, therefore, of the plan above recommended may perhaps be expected.

"The most obvious remedy apparently omitted is opium. This powerful medicine was not prescribed, as far as we have reason to know, by the practitioners who lived at the end of the 17th and beginning of the 18th centuries. The first author who, in strong terms, asserts the efficacy of opium in such cases, appears to be the

Preternatural Parturition.

translator of Astruc's Midwifery (A); and his opinion has been adopted by Dr Denman (B), and by Dr Bland (C). But in every case of true eclampsia, during pregnancy or labour, opiates do irreparable mischief, where a copious bleeding has not been premised; and even where that precaution has been attended to, they have been found useless, if not hurtful. Melancholy experience has completely established in my mind this practical precept; and I consider it to be a matter of very great moment, that it should be universally known; for general practitioners, who are often first called to those cases where the fits happen during pregnancy, are extremely apt to prescribe opium. I can solemnly declare, that no patient to whose assistance I have been called, who had taken a dose of opium previous to my arrival, has recovered, and I have known that medicine given in almost every variety of dose. My father, Dr A. Hamilton, of whose judgment and practical knowledge it does not become me to speak in the terms they so justly merit, prevented my ever employing opium under such circumstances.

"A second remedy extolled by Dr Denman, and now, after a fair trial, rejected in my practice, is vomiting. This seems to have been a very common prescription in the time of Mauriceau, as he takes great pains to point out its hurtfulness in several parts of his works (D). Where there are unequivocal marks of disordered stomach, an emetic may be prescribed with advantage after blood-letting, but it should be avoided under all other circumstances.

"With regard to the warm-bath, which is a favourite remedy among foreign practitioners, and has been advised by several British authors, I have never had an opportunity of trying its effects. Upon theoretical principles I should reject it; but my chief reason for never having directed its use, has been the impossibility, in ordinary cases of practice, of commanding a warm bath into which a woman in such a situation could be put.

"Dashing cold water by surprise upon the face is a practice suggested by Dr Denman, and on which he had much dependence at one period. Experience lessened his hopes, and, many years ago, prevented my ever indulging any. I gave it several fair trials, (once or twice in public in the lying-in-ward of the Royal Infirmary), and had even reason to be convinced, that it rather aggravated than diminished the violence of the paroxysms."

In addition to these observations it may be proper to remark, that a much larger quantity of blood should be drawn in those cases than has commonly been done. Dr H. advises forty ounces to be taken at this first bleeding, and the same quantity to be again drawn within an hour, if the symptoms be not mitigated; and he talks with the utmost confidence of the utility of this practice.

152 *f.* Although the woman be delivered safely both of the child and afterbirth, she may sink very soon after in consequence of internal flooding. This is to be suspected if the patient suddenly complain of giddiness or sickness, or singing in the ears, or impaired vision; or if she become delirious, with a pallid face and cold limbs. The state of the pulse at the wrist too should lead a judicious practitioner to suspect the existence of internal flooding. Positive certainty of this accident may be obtained by feeling through the belly the condition of the uterus; or, more certainly still, by feeling the state of the vagina, for if its parietes approach, there is not much probability of there being any considerable internal hæmorrhagy; whereas, if it be found filled with coagulated blood, there is a certainty, that the womb too is distended from the same cause.

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This accident is entirely owing to the womb not having contracted with sufficient energy. It very often proves the cause of sudden and unexpected death.

The boldest and apparently most violent measures 153
are required to save the patient in many of those cases. The womb and vagina must be immediately emptied, and such pressure must be made on the inside of the uterus with the hand, as shall force it into contraction. In some cases cold water in great quantity must be dashed from a height on the naked belly at the same time; and in the mean while the strength of the patient must be supported with large doses of opium. If there be vomiting, which is a frequent symptom in such cases, five grains of solid opium should be given at first, and afterwards three grains every three or four hours, till the pulse becomes steady and the strength recruited, when the opiates are to be withdrawn and lessened by degrees. The writer of this article cannot avoid this opportunity of paying a just tribute of respect to the practical discernment of the able editor of the New London Medical Dictionary, who seems the first author who has mentioned this practice of giving large doses of opium; a practice by which many valuable lives have been saved.

Conclusion.—In the preceding account of the deviations, which sometimes happen in the process of human parturition, although we have endeavoured to give a full view of the subject, we have not pursued the beaten tract. But as this article may rather be consulted by many as a dictionary, than pursued regularly as a treatise, we shall add the ordinary arrangement of labours, with the reference to the numerical articles, under which the several varieties may be found.

Labours are divided into four classes; viz. natural, laborious, preternatural, and complex.

Natural labour comprehends all cases where the head of the infant is forced foremost; and the whole process is completed with safety, both to mother and child, within twenty-four hours from the commencement. It is described under articles 48. to 60.

Laborious

(A) The Art of Midwifery, &c. 8vo. London, printed for J. Nourse 1767. Appendix, p. 295.
(B) Vol. ii. p. 418. (C) Loco citato, page 136.
(D) Particularly in Aphorism 232. "L'émétique est pernicieux aux femmes grosses, ou nouvellement accouchées, qui sont surprises des convulsions." And Levret, page 451. of his L'Art des Accouchemens, says, in reference to that aphorism, "Cette sentence est des mieux fondées, et elle doit être rigoureusement observée dans tous ses points."

Conclusion.

Laborious labour is that where, although the head of the infant be forced foremost, the process is protracted beyond twenty-four hours from the commencement. It is divided into three orders: First, where the natural powers at last, after much suffering on the part of the mother, complete the delivery. See article 64.

Secondly, Where, although the action of the uterus be inadequate to the expulsion of the infant, it is practicable to extract the child through the natural passages, without injury either to it or to the mother. See articles 66. to 74. 82. and 84.

Thirdly, Where it is impossible to extract the child alive through the natural passages. See articles 80. and 99. to 133.

Preternatural labours comprehend all cases where any other part of the child than the head is forced foremost; and consist of two orders:

First, Presentations of the lower extremities, viz. footling cases, article 87. Breech cases, article 91. Cases where one foot presents, article 89. and knee-cases, article 90.

Secondly, Presentations of the superior extremities or other parts than the head or lower extremities, articles 192. to 196.

Explanation of the Plates

Complex labours include all cases where any other circumstances than those enumerated under the former three classes take place, viz.

Cases where the pelvis is too large, articles 110. and 111.

Cases where hæmorrhagy occurs at the beginning of labour, article 76. or at the conclusion of that process, articles 152. and 153.

Cases where there is more than one child, articles 143, 144, 145.

Cases where the patient had previously been affected with umbilical herniæ, article 146.

Cases where convulsions happen, articles 147, 148.

Cases where the navel-string is twisted round the neck of the infant, article 140. or where it is forced down along with some part of the child, article 141.

And cases of rupture of the uterus, article 65.

EXPLANATION OF THE PLATES.

Plate CCCXLVI.

Fig. 1. A front view of the uterus in the unimpregnated state, *in situ*, suspended in the vagina; the anterior parts of the ossa ischia, with the ossa pubis, pudenda, perineum, and anus being removed, in order to show the internal parts.

A, The last lumbar vertebra.

B, B, The ossa ilia.

C, C, The acetabula.

D, D. The inferior and posterior parts of the ossa ischia.

E, The part covering the extremity of the coccyx.

F, The inferior part of the rectum.

G, G, The vagina cut open longitudinally, and stretched on each side of the cervex uteri, in order to show the manner in which the uterus is suspended in it.

H, H, Part of the urinary bladder stretched on each side of the vagina and inferior part of the fundus uteri.

I, The cervix uteri.

K, The fundus uteri.

L, L, The fallopian tubes.

M, M, The ovaria.

N, N, The broad ligaments.

O, O, The superior part of the rectum.

Fig. 2. A view of the internal parts as seen from the right groin, the pelvis having been divided vertically.

A, The lowest vertebra of the loins.

B, C, The os sacrum and coccyx with the integuments.

D, The left os ilium.

E, The inferior part of the os ischium.

F, The os pubis of the same side.

G, The foramen magnum.

H, The acetabulum.

I, The inferior part of the rectum.

K, The os externum and vagina, the os uteri lying loosely in the latter.

L, The vesica urinaria.

M, N, The cervix and fundus uteri, with a view of the cavity of the uterus. The attachment of the vagina to the uterus, and the situation of the uterus when pressed down by the intestines and bladder into the concave part of the os sacrum, are likewise shown.

O, The broad ligament of the left side.

P, P, The left fallopian tube.

Q, The left ovarium.

R, R, The superior part of the rectum and inferior part of the colon.

Fig. 3. Is a sketch taken from Dr Hunter's magnificent plate, N° 6. of the gravid uterus. All the fore part of the uterus and secundines (which included the placenta) is removed. The navel-string is cut, tied, and turned to the left side over the edge of the womb. At the fundus the investing membranes are likewise turned over the edge of the womb, that they might be more apparent. The head of the child is lodged in the lower part of the womb, or in the cavity of the pelvis, and its body lies principally in the right side. Its position is diagonal or oblique, so that its posterior parts are turned forwards, and to the right side of the mother, and its fore parts are directed backwards, and to the left side. Its right foot appears between its left thigh and leg. Every part is stated by Dr Hunter to have been represented just as it was found.

Fig. 4. A front view of the gravid uterus in the first stage of labour; the anterior parts are removed, but the membranes not being ruptured, form a large bag containing the fœtus and the liquor amnii.

A, A, The substance of the uterus.

B, B, C, C, D, D, E, E, The bones of the pelvis.

G, G, The vagina.

H, H, The os uteri dilated during a pain; with

I, The membranes containing the liquor amnii protruding through it.

K, The chorion.

Explanation of the Plates.

L, The chorion dissected off at the back of the uterus, to show the head of the child through the amnios.

M, The placenta; the lobulated surface, or that which is attached to the uterus, being shown.

Plate CCCXLVII.

Fig. 1. Represents a well-formed pelvis.

A, A, The ossa ilia, properly so called.

a, *a*, The iliac fossæ.

b, *b*, The linea innominata, making part of the brim of the pelvis.

c, *c*, The crista of the ossa ilia.

e, *e*, Their superior anterior spinous processes.

B, B, The os ischium.

f, *f*, Its tuberosities.

h, *h*, Its branches.

C, C, The body of the os pubis.

i, *i*, The crista pubis.

k, *k*, Its descending branch uniting with that of the ischium.

l, The symphysis pubis.

D, D, The os sacrum.

m, *m*, Its base.

n, *n*, The sacro-iliac synchondrosis.

o, Its internal surface called *hollow*.

p, Its apex to which the coccyx is joined.

E, The coccyx.

Fig. 2. Represents a vertical section of the pelvis.

A, The promontory of the sacrum.

B, The point of the coccyx.

The distance from these two points marks the depth of the pelvis behind, which in the majority of cases is six inches.

C, The spinous process of the ischium.

D, The tuberosity of the ischium.

E, The crista pubis, the distance which two points marks the depth of the pelvis at the sides, and is ordinarily about four inches.

F, The foramen thyroideum.

G, The surface by which the two ossa pubis are joined to form the symphysis pubis, and by which junction the depth of the pelvis at the front is reduced to about one and a half inch.

Fig. 3. Represents the brim of a well-formed pelvis.

A, B, The short or conjugate diameter between pubis and sacrum, which measures commonly a little less than four inches.

C, D, The long diameter in the skeleton, which, however, in the living subject, is rendered almost as short as the former, in consequence of the bellies of the psoæ muscles being lodged in the lower cavity of the tunica innominata.

E, F, The diagonal diameter in the skeleton, which, in fact, is the long diameter in the living body, and measures somewhat less than five inches.

Fig. 4. Represents the outlet of a well-formed pelvis.

A, B, The short diameter, extending from one tuberosity of the ischium to the other, and measuring less than four inches.

C, D, The long diameter, extending from the lower edge of the symphysis pubis to the point of the coccyx, and measuring nearly five inches.

Fig. 5. Represents the brim of a distorted pelvis.

Fig. 6. Represents the outlet of a deformed pelvis.

Plate CCCXLVIII.

Explanation of the Plates.

Fig. 1. The fœtal heart.

a, The right ventricle.

b, The right auricle.

c, The left auricle.

d, Branches of the pulmonary veins of the right lobe of the lungs, those of the left being cut off short.

e, Arteries of the left lobe of the lungs.

f, The vena cava descendens.

g, The aorta descedens.

h, The trunk of the arteria pulmonalis.

i, The ductus arteriosus.

Fig. 2. Represents the first stage of natural labour, towards its termination.

A, The membranes of the ovum distending the cervix uteri, while the head of the child is just entering the brim of the pelvis.

B, B, The os uteri nearly dilated.

C, The vagina.

D, The orificium externum.

Fig. 3. Represents the second stage of natural labour, when the head has descended into the cavity of the pelvis, while the face is still towards the sacro-iliac synchondrosis.

Fig. 4. Represents the second stage of natural labour, after the head has advanced so far that the face is in the hollow of the sacrum, and the vertex in the arch of the pubis.

Plate CCCXLIX.

Fig. 1. A view of a deformed pelvis when the deficiency of space is not very considerable.

Fig. 2. The child's skull.

a, The vertex, or posterior fontanelle.

b, The anterior fontanelle.

Fig. 3. and 4. The common short forceps, reduced to one-fourth of the natural size.

The instrument, when of the proper size, is in length 11 inches. The length of each handle is four inches and a half. If a straight line be drawn through the plane surface of one handle, and be produced to the extremity of the instrument (which forms the axis of the handles when both are joined), the convex edge of the blade, at the greatest distance from this line, is distant $1\frac{3}{8}$ inch; and the extreme distance of the point on the opposite edge is $\frac{7}{16}$ths of an inch. When both blades are joined, their greatest width is $2\frac{3}{4}$ inches. The right-hand blade has a hinge between the handle and blade, by which it is easily introduced, while the patient lies on the left side.

Fig. 5. and 6. Views of Lowder's lever; for a particular description of which, see art. 69.

Fig. 7. Orme's perforator reduced to one-fourth the natural size.

Fig. 8. Embryotomy forceps, one-fourth the natural size.

Fig. 9. The crotchet, one-fourth the natural size.

Plate CCCL.

Fig. 1. Represents an ordinary sized child forced against the brim of a deformed pelvis.

Fig. 2. Represents the child when the feet had presented, turned into that direction by which its head is best

Fig. 1.

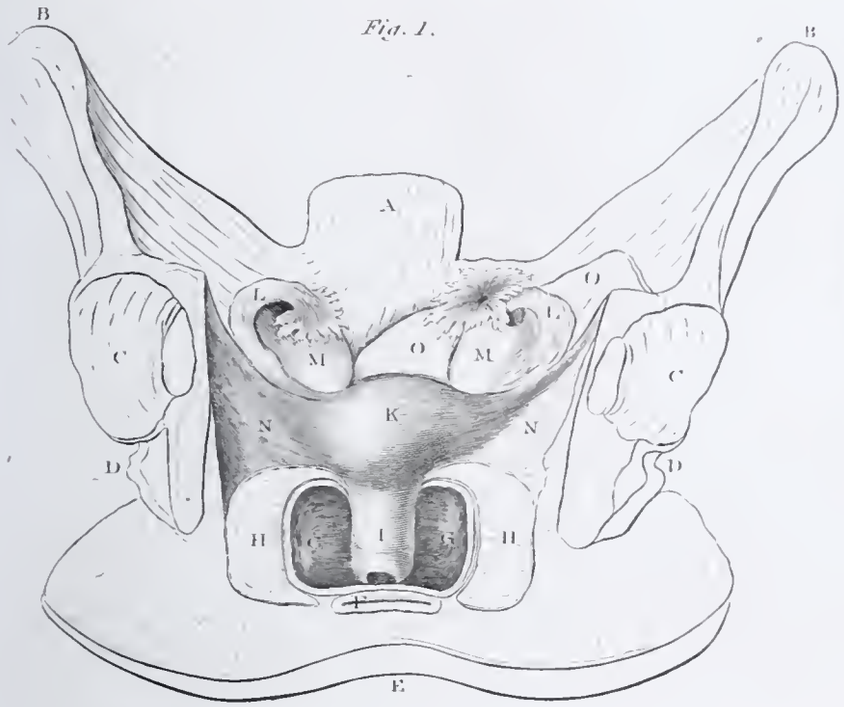


Fig 2.

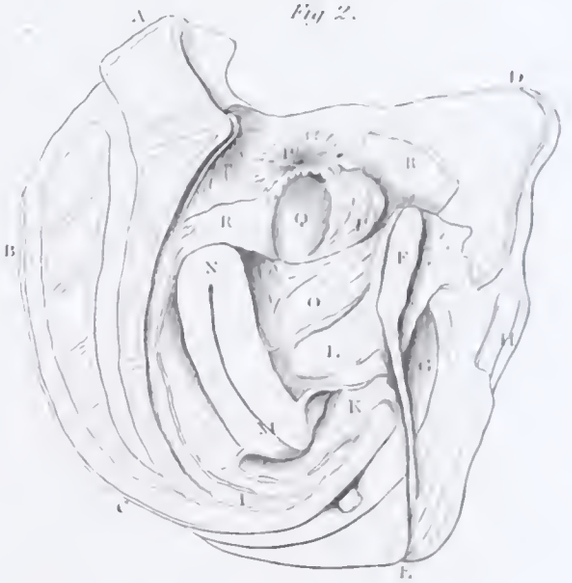


Fig 4.

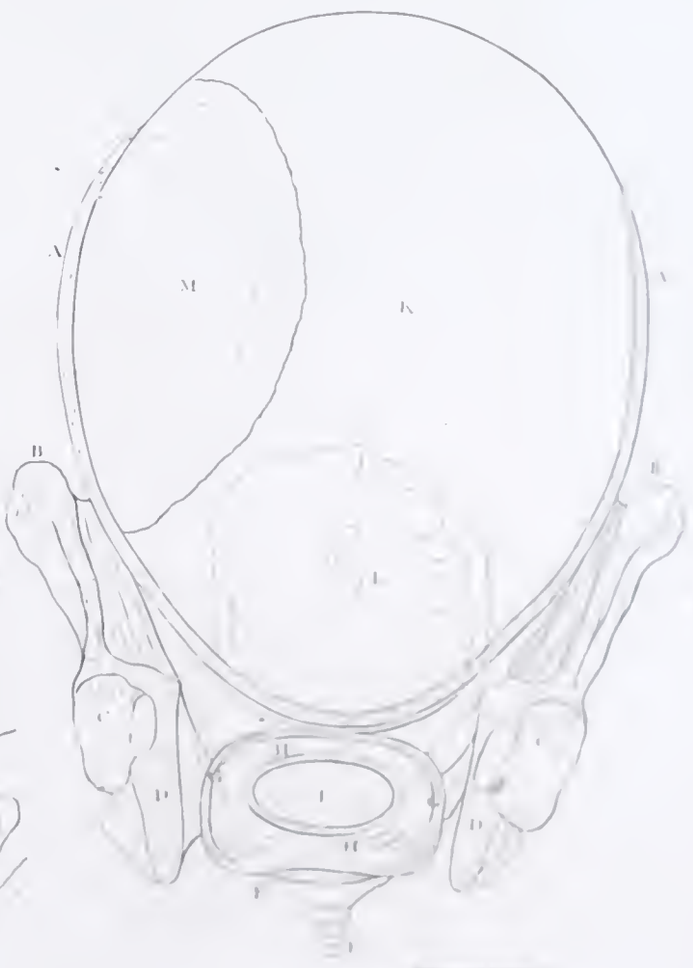


Fig.3.



Fig. 1.



Fig. 2.



Fig. 3.

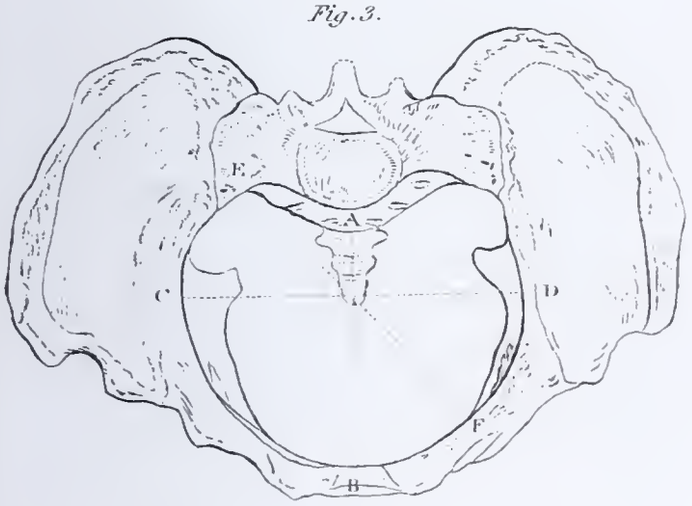


Fig. 4.



Fig. 5.

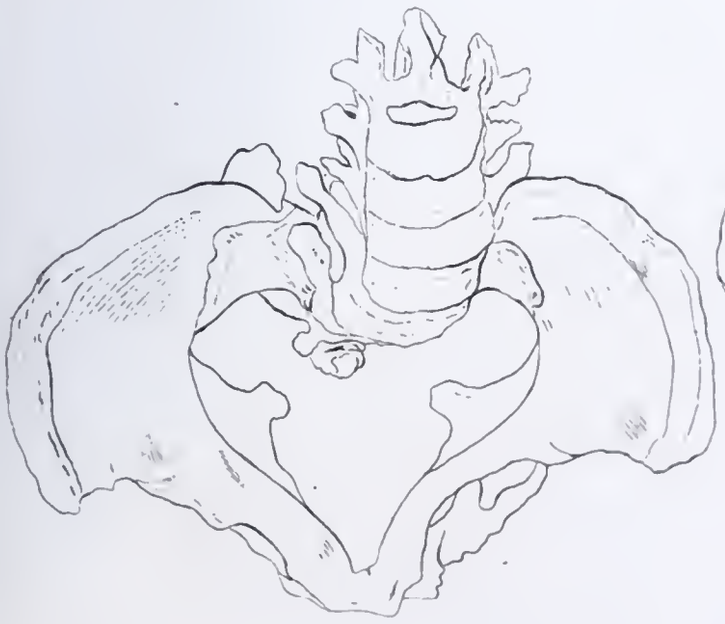


Fig. 6.



Fig. 1.

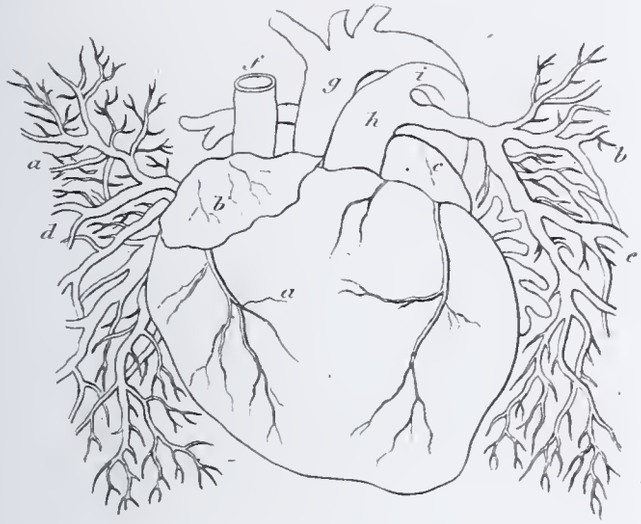


Fig. 2.



Fig. 3.



Fig. 4.



Fig. 1.



Fig. 2.



Fig. 3.



Fig. 4.



Fig. 9.



Fig. 5.



Fig. 6.



Fig. 7.



Fig. 8.

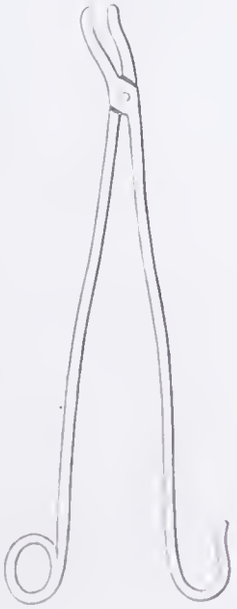


Fig. 3.



Fig. 2.



Fig. 1.



Fig. 4.



best brought through the brim and cavity of the pelvis, viz. with the face towards the sacro-iliac synchondrosis of one side.

Fig. 3. Represents the ordinary situation of the infant in breech presentations; from which it is evident, that unless the infant be very small, the natural action of the uterus cannot force it through the pelvis in this direction.

Fig. 4. Represents an arm presentation, and communicates an idea of the difficulty of bringing down the feet, and turning the infant in that position.

M I E

Miedniki || Mieris.

MIEDNIKI, or MEDNIKI, or *Warmic*, a town of Samogitia, and the residence of the bishop. It is 28 miles N. E. from Konigsberg, and 60 miles S.S.W. from Mittau.

MIEKOW, a town of Austrian Poland, in the palatinate of Cracow. The founder of this town is said to have been Gripsius Jana, who built it after the model of Jerusalem, when he returned from a pilgrimage to that city. It is 12 miles north from Cracow.

MIEL, JAN, called *Giovanni della Vite*, a most eminent painter, was born in Flanders in 1599. He was at first a disciple of Gerard Seghers, in whose school he made a distinguished figure; but he quitted that artist, and went to Italy, to improve himself in design, and to obtain a more extensive knowledge of the several branches of his art. At Rome he particularly studied and copied the works of the Caracci and Corregio; and was admitted into the academy of Andrea Sacchi, where he gave such evident proofs of extraordinary merit and genius, that he was invited by Andrea to assist him in a grand design which he had already begun. But Miel, through some disgust, rejected those elevated subjects which at first had engaged his attention, refused the friendly proposal of Sacchi, and chose to imitate the style of Bamboccio, as having more of that nature which pleased his own imagination. His general subjects were huntings, carnivals, gypsies, beggars, pastoral scenes, and conversations; of those he composed his easel pictures, which are the finest of his performances. But he also painted history in a large size in fresco, and in oil; which, though they seem to want elevation of design, and a greater degree of grace in the heads, yet appear superior to what might be expected from a painter of such low subjects as he generally was fond of representing. His pictures of huntings are particularly admired: the figures and animals of every species being designed with uncommon spirit, nature, and truth. The transparence of his colouring, and the clear tints of his skies, enliven his compositions; nor are his paintings in any degree inferior to those of Bamboccio either in their force or lustre. His large works are not so much to be commended for the goodness of the design as for the expression and colouring; but it is in his small pieces that the pencil of Miel appears in its greatest delicacy and beauty. The singular merit of this master recommended him to the favour of Charles Emanuel duke of Savoy, who invited him to his court, where he appointed Miel his principal painter, and afterwards honoured him with the order of St Mauritius, and made him a present of a cross set with diamonds of great value, as a particular mark of his esteem. He died in 1664.

MIERIS, FRANCIS, the *Old*, a justly celebrated painter, was born at Leyden in 1635; and was at first placed under the direction of Abraham Toorne Vliet, one of the best designers of the Low Countries, and afterwards entered himself as a disciple with Gerard Douw. In a short time he far surpassed all his companions, and was by his master called the prince of his disciples. His manner of painting silks, velvets, stuffs, or carpets, was so singular, that the different kinds and fabric of any of them might easily be distinguished. His pictures are rarely to be seen, and as rarely to be sold; and when they are, the purchase is extremely high, their intrinsic value being so incontestably great. Besides portraits, his general subjects were conversations, persons performing on musical instruments, patients attended by the apothecary or doctor, chemists at work, mercers shops, and such like; and the usual valuation he set on his pictures was estimated at the rate of a ducat an hour. The finest portrait of this master's hand is that which he painted for the wife of Cornelius Plaats, which is said to be still preserved in the family, although very great sums have been offered for it. In the possession of the same gentleman was another picture of Mieris, representing a lady fainting, and a physician applying the remedies to relieve her. For that performance he was paid (at his usual rate of a ducat an hour) so much money as amounted to fifteen hundred florins when the picture was finished. The grand duke of Tuscany wished to purchase it, and offered three thousand florins for it; but the offer was not accepted. However, that prince procured several of his pictures, and they are at this day an ornament to the Florentine collection. One of the most curious of them is a girl holding a candle in her hand, and it is accounted inestimable. This painter died in 1681.

M I E

Mieris.

MIERIS, *William*, called the *Young Mieris*, was son of the former, and born at Leyden in 1662. During the life of his father, he made a remarkable progress: but, by being deprived of his director when he was only arrived at the age of nineteen, he had recourse to nature, as the most instructive guide; and by studying with diligence and judgment to imitate her, he approached near to the merit of his father. At first he took his subjects from private life, in the manner of Francis; such as tradesmen in their shops, or a peasant selling vegetables and fruit, and sometimes a woman looking out at a window; all which he copied minutely after nature, nor did he paint a single object without his model. As Mieris had observed the composition of Gerard Lairesse, and other great historical painters, with singular delight, he attempted to design subjects in that style; and began with the story of Rinaldo sleeping on the lap of Armida, surrounded with the Loves and Graces, the fore ground being enriched with plants and flowers; a work which added greatly to his fame, and was sold for a very high price. This master also painted landscapes and animals with equal truth and neatness; and modelled in clay and wax, in so sharp and accurate a manner, that he might justly

Mieris || Mignon.

be ranked among the most eminent sculptors. In the delicate finishing of his works, he imitated his father; as he likewise did in the lustre, harmony, and truth, of his paintings, which makes them to be almost as highly prized; but they are not equal in respect of design, or of the striking effect, nor is his touch so very exquisite as that of the father. The works of the old Mieris are better composed, the figures are better grouped, and they have less confusion; yet the younger Mieris is acknowledged to be an artist of extraordinary merit, although inferior to him, who had scarcely his equal. He died in 1747.

MIERIS, *Francis*, called the *Young Francis*, was the son of William, and the grandson of the celebrated Francis Mieris; and was born at Leyden in 1689. He learned the art of painting from his father, whose manner and style he always imitated; he chose the same subjects, and endeavoured to resemble him in his colouring and pencil. But with all his industry he proved far inferior to him: and most of those pictures which at the public sales are said to be of the young Mieris, and many also in private collections ascribed to the elder Francis, or William, are perhaps originally painted by this master, who was far inferior to both; or are only his copies after the works of those excellent painters, as he spent abundance of his time in copying their performances.

MIEZA, in *Ancient Geography*, a town of Macedonia, which was anciently called *Strymonium*, situated near Stagira. Here, Plutarch informs us, the stone seats and shady walks of Aristotle were shown. Of this place was Peucestas, one of Alexander's generals, and therefore surnamed *Miezæus*, (Arrian).

MIGDOL, or MAGDOL, in *Ancient Geography*, a place in the Lower Egypt, on this side Pihahiroth, or between it and the Red sea, towards its extremity. The term denotes a tower or fortress. It is probably the *Magdolum* of Herodotus, seeing the Septuagint render it by the same name.

MIGNARD, NICHOLAS, an ingenious French painter born at Troyes in 1628; but, settling at Avignon, is generally distinguished from his brother Peter by the appellation of *Mignard of Avignon*. He was afterwards employed at court and at Paris, where he became rector of the royal academy of painting.

There is a great number of his historical pieces and portraits in the palace of the Thuilleries. He died in 1690.

MIGNARD, *Peter*, the brother of Nicholas, was born at Troyes in 1610; and acquired so much of the taste of the Italian school, as to be known by the name of the *Roman*. He was generally allowed to have a superior genius to his brother Nicholas; and had the honour of painting the popes Alexander VII. and Urban VIII. besides many of the nobility at Rome, and several of the Italian princes: his patron, Louis, sat ten times to him for his portrait, and respected his talents so much as to ennoble him, make him his principal painter after the death of Le Brun, and appointed him director of the manufactories. He died in 1695, and many of his pieces are to be seen at St Cloud.

MIGNON, or MINJON, *Abraham*, a celebrated painter of flowers and still life, was born at Francfort in 1639; and his father having been deprived of the greatest part of his substance by a series of losses in trade, left him in very necessitous circumstances when he was only seven years of age. From that melancholy situation he was rescued by the friendship of James Murel, a flower painter in that city; who took Mignon into his own house, and instructed him in the art, till he was 17 years old. Murel had often observed an uncommon genius in Mignon: he therefore took him along with him to Holland, where he placed him as a disciple with David de Heem; and while he was under the direction of that master he laboured with incessant application to imitate the manner of De Heem, and ever afterwards adhered to it; only adding daily to his improvement, by studying nature with a most exact and curious observation.—"When we consider the paintings of Mignon, one is at a loss (Mr Pilkington observes) whether more to admire the freshness and beauty of his colouring, the truth in every part, the bloom on his objects, or the perfect resemblance of nature visible in all his performances. He always shows a beautiful choice in those flowers and fruits from which his subjects are composed: and he groups them with uncommon elegance. His touch is exquisitely neat, though apparently easy and unlaboured; and he was fond of introducing insects among the fruits and flowers, wonderfully finished, so that even the drops of dew appear as round and as translucent as nature itself." He had the good fortune to be highly paid for his works in his lifetime; and he certainly would have been accounted the best in his profession even to this day, if John Van Huysum had not appeared. Weyerman, who had seen many admired pictures of Mignon, mentions one of a most capital kind. The subject of it is a cat, which had thrown down a pot of flowers, and they lie scattered on a marble table. That picture is in every respect so wonderfully natural, that the spectator can scarce persuade himself that the water which is spilled from the vessel is not really running down from the marble. This picture is distinguished by the title of *Mignon's Cat*. This painter died in 1679, aged only 40.

Mignon, Migration.

MIGRATION, the passage or a removal of a thing out of one place into another.

1 Migration generally believed.

MIGRATION of Birds.—It has been generally believed, that many different kinds of birds annually pass from one country to another, and spend the summer or the winter where it is most agreeable to them; and that even the birds of our own island will seek the most distant southern regions of Africa, when directed by a peculiar instinct to leave their own country. It has long been an opinion pretty generally received, that swallows reside during the winter season in the warm southern regions; and Mr Adanson particularly relates his having seen them at Senegal when they were obliged to leave this country. But besides the swallow, Mr Pennant enumerates many other birds which migrate from Britain at different times of the year, and are then to be found in other countries; after which they again leave these countries, and return to Britain. The reason of these migrations he supposes to be a defect of food at certain seasons of the year, or the want of a secure asylum from the persecution of man during the time of courtship, incubation, and nutrition. The following is his list of the migrating species.

2 Birds that migrate.

1. *Crows.* Of this genus, the hooded crow migrates regularly with the woodcock. It inhabits North Britain the whole year: a few are said annually to breed

Migration. on Dartmoor, in Devonshire. It breeds also in Sweden and Austria: in some of the Swedish provinces it only shifts its quarters, in others it resides throughout the year. Our author is at a loss for the summer retreat of those which visit us in such numbers in winter, and quit our country in the spring; and for the reason why a bird, whose food is such that it may be found at all seasons in this country, should leave us.

2. *Cuckoo.* Disappears early in autumn; the retreat of this and the following bird is quite unknown to us.

3. *Wryneck.* Is a bird that leaves us in the winter. If its diet be ants alone, as several assert, the cause of its migration is very evident. This bird disappears before winter, and revisits us in the spring a little earlier than the cuckoo.

4. *Hoopoe.* Comes to England but by accident; Mr Pennant once indeed heard of a pair that attempted to make their nest in a meadow at Selborne, Hampshire, but were frightened away by the curiosity of people. It breeds in Germany.

5. *Grous.* The whole tribe, except the quail, lives here all the year round: that bird either leaves us, or else retires towards the sea coasts.

6. *Pigeons.* Some few of the ring doves breed here; but the multitude that appears in the winter is so disproportioned to what continue here the whole year, as to make it certain that the greatest part quit the country in the spring. It is most probable they go to Sweden to breed, and return from thence in autumn; as Mr Ekmark informs us they entirely quit that country before winter. Multitudes of the common wild pigeons also make the northern retreat, and visit us in winter; not but numbers breed in the high cliffs in all parts of this island. The turtle also probably leaves us in the winter, at least changes its place, removing to the southern countries.

7. *Stare.* Breeds here. Possibly several remove to other countries for that purpose, since the produce of those that continue here seems unequal to the clouds of them that appear in winter. It is not unlikely that many migrate into Sweden, where Mr Berger observes they return in spring.

8. *Thrushes.* The fieldfare and the redwing breed and pass their summers in Norway and other cold countries; their food is berries, which abounding in our kingdoms, tempts them here in the winter. These two and the Royston crow are the only land birds that regularly and constantly migrate into England, and do not breed here. The hawfinch and crossbill come here at such uncertain times as not to deserve the name of birds of passage.

9. *Chatterer.* The chatterer appears annually about Edinburgh in flocks during winter; and feeds on the berries of the mountain ash. In South Britain it is an accidental visitant.

10. *Grosbeaks.* The grosbeak and crossbill come here but seldom; they breed in Austria. The pine grosbeak probably breeds in the forests of the Highlands of Scotland.

11. *Buntings.* All the genus inhabits England throughout the year; except the greater brambling, which is forced here from the north in very severe seasons.

12. *Finches.* All continue in some parts of these kingdoms, except the siskin, which is an irregular visitant, said to come from Russia. The linnets shift their quarters, breeding in one part of this island, and remove with their young to others. All finches feed on the seeds of plants. Migration.

13. *Larks, fly-catchers, wag-tails,* and *warblers.* All of these feed on insects and worms; yet only part of them quit these kingdoms; though the reason of migration is the same to all. The nightingale, blackcap, fly-catcher, willow-wren, wheat-ear, and whitethroat, leave us before winter, while the same and delicate golden-crested wren braves our severest frosts. The migrants of this genus continue longest in Great Britain in the southern counties, the winter in those parts being later than in those of the north; Mr Stillingfleet having observed several wheat-ears in the isle of Purbeck on the 18th of November. As these birds are incapable of very distant flights, Spain, or the south of France, is probably their winter asylum.

14. *Swallows and goatsucker.* Every species disappears at the approach of winter.

Water-Fowl.

On the vast variety of water fowl that frequent Great Britain, it is amazing to reflect how few are known to breed here: the cause that principally urges them to leave this country, seems to be not merely the want of food, but the desire of a secure retreat. Our country is too populous for birds so shy and timid as the bulk of these are: when great part of our island was a mere waste, a tract of woods and fen, doubtless many species of birds (which at this time migrate) remained in security throughout the year.—Egrets, a species of heron now scarcely known in this island, were in former times in prodigious plenty; and the crane, that has totally forsaken this country, bred familiarly in our marshes: their place of incubation, as well as of all other cloven-footed water-fowl (the heron excepted), being on the ground, and exposed to every one. As rural economy increased in this country, these animals were more and more disturbed; at length, by a series of alarms, they were necessitated to seek, during the summer, some lonely safe habitation. Water-fowl.

On the contrary, those that build or lay in the almost inaccessible rocks that impend over the British seas, breed there still in vast numbers, having little to fear from the approach of mankind: the only disturbance they meet with in general being from the desperate attempts of some few to get their eggs.

Cloven-footed Water-fowl.

15. *Herons.* The white heron is an uncommon bird, and visits us at uncertain seasons; the common kind and the bittern never leave us.

16. *Curlews.* The curlew breeds sometimes on our mountains: but, considering the vast flights that appear in winter, it is probable that the greater part retire to other countries: the whimbrel breeds on the Grampian hills, in the neighbourhood of Invercauld.

17. *Snipes.* The woodcock breeds in the moist woods of Sweden, and other cold countries. Some snipes breed here, but the greatest part retire elsewhere: as do every other species of this genus.

18. *Sandpipers.* The lapwing continues here the whole year: the ruff breeds here, but retires in winter; the

Migration. the redshank and sandpiper breed in this country, and reside here. All the others absent themselves during summer.

19. *Plovers and oyster-catcher.* The long-legged plover and sanderling visit us only in winter; the dottrel appears in spring and in autumn; yet, what is very singular, we do not find it breeds in South Britain. The oyster-catcher lives with us the whole year. The Norfolk plover and sea-lark breed in England. The green plover breeds on the mountains of the north of England, and on the Grampian hills.

We must here remark, that every species of the genera of curlews, woodcocks, sandpipers, and plovers, that forsakes us in the spring, retires to Sweden, Poland, Prussia, Norway, and Lapland, to breed: as soon as the young can fly, they return to us again, because the frosts which set in early in those countries totally deprive them of the means of subsisting; as the dryness and hardness of the ground, in general, during our summer, prevent them from penetrating the earth with their bills, in search of worms, which are the natural food of these birds. Mr Ekmark speaks thus of the retreat of the whole tribe of cloven-footed water-fowl out of his country (Sweden) at the approach of winter; and Mr Klein gives much the same account of those of Poland and Prussia.

20. *Rails and gallinules.* Every species of these two genera continues with us the whole year; the land-rail excepted, which is not seen here in winter. It likewise continues in Ireland only during the summer months, when they are very numerous, as Mr Smith tells us in the History of Waterford, p. 336. Great numbers appear in Anglesea the latter end of May; it is supposed that they pass over from Ireland, the passage between the two islands being but small. As we have instances of these birds lighting on ships in the Channel and the bay of Biscay, we may conjecture their winter quarters to be in Spain.

Finned-footed Water Birds.

21. *Phalaropes.* Visit us but seldom; their breeding place is Lapland, and other arctic regions.

22. *Grebes.* The great crested grebe, the black and white grebe, and little grebe, breed with us, and never migrate; the others visit us accidentally, and breed in Lapland.

Web-footed Birds.

23. *Avoset.* Breed near Fossdike in Lincolnshire, but quit their quarters in winter. They are then shot in different parts of the kingdom, which they visit, not regularly, but accidentally.

24. *Auks and guillemots.* The great auk or pinguin sometimes breeds in St Kilda. The auk, the guillemot, and puffin, inhabit most of the maritime cliffs of Great Britain, in amazing numbers, during summer. The black guillemot breeds in the Bass isle, and in St Kilda, and sometimes in Llandidno rocks. We are at a loss for the breeding place of the other species; neither can we be very certain of the winter residence of any of them, excepting of the lesser guillemot and black-billed auk, which, during winter, visit in vast flocks the frith of Forth.

25. *Divers.* These chiefly breed in the lakes of Sweden and Lapland, and in some countries near the pole; but some of the red-throated divers, the northern and the imber, may breed in the north of Scotland and its isles. Migration

26. *Terns.* Every species breeds here; but leaves us in the winter.

27. *Petrels.* The fulmar breeds in the isle of St Kilda, and continues there the whole year except September and part of October: the shearwater visits the isle of Man in April; breeds there; and, leaving it in August or the beginning of September, disperses over all parts of the Atlantic ocean. The stormfinch is seen at all distances from land on the same vast watery tract; nor is ever found near the shore except by some very rare accident unless in the breeding season. Mr Pennant found it on some little rocky isles off the north of Skye. It also breeds in St Kilda. He also suspects that it nestles on the Blasquet isles off Kerry, and that it is the gourder of Mr Smith.

28. *Mergansers.* This whole genus is mentioned among the birds that fill the Lapland lakes during summer. Mr Pennant has seen the young of the red-breasted in the north of Scotland: a few of these, and perhaps of the goosanders, may breed there.

29. *Ducks.* Of the numerous species that form this genus, we know of few that breed here: The swan and goose, the shield duck, the eider duck, a few shovelers, garganies, and teals, and a very small portion of the wild ducks.

The rest contribute to form that amazing multitude of water-fowl that annually repair from most parts of Europe to the woods and lakes of Lapland and other arctic regions, there to perform the functions of incubation and nutrition in full security. They and their young quit their retreat in September, and disperse themselves over Europe. With us they make their appearance the beginning of October; circulate first round our shores; and, when compelled by severe frost, betake themselves to our lakes and rivers. Of the web-footed fowl there are some of hardier constitutions than others: these endure the ordinary winters of the more northern countries; but when the cold reigns there with more than common rigour, they repair for shelter to these kingdoms: this regulates the appearance of some of the diver kind, as also of the wild swans, the swallow-tailed shield duck, and the different sorts of goosanders which then visit our coasts. Barenta found the barnacles with their nests in great numbers in Nova Zembla. (*Collect. Voy. Dutch East-India Company*, 8vo, 1703, p. 19.). Clusius, in his *Exot.* 368. also observes, that the Dutch discovered them on the rocks of that country and in Waygate straits. They, as well as the other species of wild geese, go very far north to breed, as appears from the histories of Greenland and Spitzbergen, by Egede and Crantz. These birds seem to make Iceland a resting place, as Horrebow observes: few continue there to breed, but only visit that island in the spring, and after a short stay retire still further north.

30. *Corvorants.* The corvorant and shag breed on most of our high rocks: the gannet in some of the Scotch isles and on the coast of Kerry: the two first continue on our shores the whole year. The gannet disperses itself all round the seas of Great Britain, in pursuit of the herring and pilchard, and even as far as the Tagus to prey on the sardina.

Migration.

But of the numerous species of fowl here enumerated, it may be observed how very few intrust themselves to us in the breeding season, and what a distant flight they make to perform the first great dictate of nature.

4 Few breed in this country.

There seems to be scarcely any but what we have traced to Lapland, a country of lakes, rivers, swamps, and alps, covered with thick and gloomy forests, that afford shelter during summer to these fowls, which in winter disperse over the greatest part of Europe. In those arctic regions, by reason of the thickness of the woods, the ground remains moist and penetrable to the woodcocks, and other slender-billed fowl: and for the web-footed birds, the waters afford larvæ innumerable of the tormenting gnat. The days there are long; and the beautiful meteorous nights indulge them with every opportunity of collecting so minute a food: whilst mankind is very sparingly scattered over that vast northern waste.

Why then should Linnæus, the great explorer of these rude deserts, be amazed at the myriads of waterfowl that migrated with him out of Lapland? which exceeded in multitude the army of Xerxes; covering, for eight whole days and nights, the surface of the river Calix! His partial observation as a botanist, would confine their food to the vegetable kingdom, almost denied to the Lapland waters; inattentive to a more plenteous table of insect food, which the all-bountiful Creator had spread for them in the wilderness. It may be remarked, that the lakes of mountainous rocky countries in general are destitute of plants: few or none are seen on those of Switzerland; and Linnæus makes the same observation in respect to those of Lapland; having, during his whole tour, discovered only a single specimen of a *lemma trisculca*, or "ivy-leaved duck's meat," *Flora Lap.* N° 470.; a few of the *scirpus lacustris*, or "bulrush," N° 18.; the *alopecurus geniculatus*, or "flote foxtail-grass," N° 38.; and the *ranunculus aquatilis*, N° 234.; which are all he enumerates in his *Prolegomena* to that excellent performance.

5 Arguments against migration.

We shall afterwards state the principal arguments for and against the migration of swallows; but here we shall give a short abstract of the arguments used by the Hon. Daines Barrington against the migration of birds in general, from a paper published by him in the 62d volume of the Philosophical Transactions. This gentleman denies that any well-attested instances can be produced of this supposed migration; which, he thinks, if there were any such periodical flight, could not possibly have escaped the frequent observation of seamen. It has indeed been asserted that birds of passage become invisible in their flight, because they rise too high in the air to be perceived, and because they choose the night for their passage. The author, however, expresses his doubts "whether any bird was ever seen to rise to a greater height than perhaps twice that of St Paul's cross;" and he further endeavours to show, that the extent of some of these supposed migrations (from the northern parts of Europe, for instance, to the line) is too great to be accounted for, by having recourse to the argument founded on a nocturnal passage.

The author next recites, in a chronological order, all the instances that he has been able to collect, of birds having been actually seen by mariners when they were crossing a large extent of sea; and he endeavours to show that no stress can be laid on the few casual observations of this kind that have been produced in support of the doctrine of a regular and periodical migration. Migration.

Mr Barrington afterwards proceeds to invalidate M. Adanson's celebrated observation with respect to the migration of the swallow in particular, and which has been considered by many as perfectly decisive of the present question. He endeavours to show that the four swallows which that naturalist caught, on their settling upon his ship, on the 6th of October, at about the distance of 50 leagues from the coast of Senegal, and which he supposes to have been then proceeding from Europe to pass the winter in Africa, could not be true European swallows; or, if they were, could not have been on their return from Europe to Africa. His objections are founded principally on some proofs which he produces of M. Adanson's want of accuracy on this subject, which has led him, in the present instance, to mistake two African species of the swallow tribe, described and engraved by Brisson, for European swallows, to which they bear a general resemblance; or granting even that they were European swallows, he contends that they were flitting from the Cape de Verd islands to the coast of Africa; "to which short flight, however, they were unequal, and accordingly fell into the sailors hands."—We shall here only add, in opposition to the remarks of Mr Barrington, the following observations of the Rev. Mr White* in a letter to Mr Pennant on this subject. * *Natural History of Selborne*, letter ix. p. 130.

6 Arguments in support of it.

"We must not (says he) deny migration in general; because migration certainly does subsist in some places, as my brother in Andalusia has fully informed me. Of the motions of these birds he has ocular demonstration, for many weeks together, both spring and fall: during which periods myriads of the swallow kind traverse the Straits from north to south, and from south to north, according to the season. And these vast migrations consist not only of hirundines, but of bee-birds, hoopoes, oro pendolos or golden thrushes, &c. &c. and also of many of our soft-billed summer birds of passage; and moreover of birds which never leave us, such as all the various sorts of hawks and kites. Old Belon, 200 years ago, gives a curious account of the incredible armies of hawks and kites which he saw in the spring time traversing the Thracian Bosphorus from Asia to Europe. Besides the above mentioned, he remarks that the procession is swelled by whole troops of eagles and vultures.

"Now it is no wonder that birds residing in Africa should retreat before the sun as it advances, and retire to milder regions, and especially birds of prey, whose blood being heated with hot animal food, are more impatient of a sultry climate: but then I cannot help wondering why kites and hawks, and such hardy birds as are known to defy all the severity of England, and even of Sweden and all northern Europe, should want to migrate from the south of Europe, and be dissatisfied with the winters of Andalusia.

"It does not appear to me that much stress may be laid on the difficulty and hazard that birds must run in their migrations, by reason of vast oceans, cross winds, &c.; because, if we reflect, a bird may travel from England to the equator without launching out and ex-

Migration. posing itself to boundless seas; and that by crossing the water at Dover and again at Gibraltar. And I with the more confidence advance this obvious remark, because my brother has always found that some of his birds, and particularly the swallow kind, are very sparing of their pains in crossing the Mediterranean: for when arrived at Gibraltar, they do not,

——"rang'd in figure, wedge their way,
——"and set forth:
"Their airy caravan high over seas
"Flying, and over lands with mutual wing
"Easing their flight"— MILTON.

but scout and hurry along in little detached parties of six or seven in a company; and sweeping low, just over the surface of the land and water, direct their course to the opposite continent at the narrowest passage they can find. They usually slope across the bay to the south-west, and so pass over opposite to Tangier, which it seems is the narrowest space.

"In former letters we have considered whether it was probable that woodcocks in moon-shiny nights cross the German ocean from Scandinavia. As a proof that birds of less speed may pass that sea, considerable as it is, I shall relate the following incident, which, though mentioned to have happened so many years ago, was strictly matter of fact:—As some people were shooting in the parish of Trotton, in the county of Sussex, they killed a duck in that dreadful winter 1708-9, with a silver collar about its neck (I have read a like anecdote of a swan), on which were engraven the arms of the king of Denmark. This anecdote the rector of Trotton at that time has often told to a near relation of mine; and, to the best of my remembrance, the collar was in the possession of the rector.

"At present I do not know any body near the sea side that will take the trouble to remark at what time of the moon woodcocks first come. One thing I used to observe when I was a sportsman, that there were times in which woodcocks were so sluggish and sleepy that they would drop again when flushed just before the spaniels, nay, just at the muzzle of a gun that had been fired at them: whether this strange laziness was the effect of a recent fatiguing journey, I shall not presume to say.

"Nightingales not only never reach Northumberland and Scotland, but also, as I have been always told, Devonshire and Cornwall. In those two last counties we cannot attribute the failure of them to the want of warmth: the defect in the west is rather a presumptive argument that these birds come over to us from the continent at the narrowest passage, and do not stroll so far westward."

7 Question, What becomes of swallows in winter?

Upon the subject of the migration of the swallow there are three opinions. Some say that it migrates to a warmer climate; some, that it retires to hollow trees and caverns, where it lies in a torpid state; and others have affirmed, that it lies in the same state in the bottom of lakes and under the ice. The first opinion is supported by Marsigli, Ray, Willoughby, Cateshy, Reaumur, Adanson, Buffon, &c. The first and second opinion are both adopted by Pennant and White. The third is sanctioned by Schæffer, Hevelius, Derham, Klein, Ellis, Linnæus, Kalm: and the second and third have been strongly defended by the honourable Daines Barrington. Migration.

Though we cannot help giving a preference to that opinion which appears the most probable, yet we do not think that any one of them is established upon such evidence as so curious a subject requires, and as the advanced state of natural history would lead us to expect. We shall therefore state the arguments upon which each opinion is founded as fairly and distinctly as we can, and as often as possible in the very words of their respective advocates. By doing so, we shall place the whole subject before the eyes of our readers, who will thus have an opportunity of examining it attentively, and of making such observations and experiments as may lead to the truth.

8 First opinion stated, that they migrate to warm climates.

Those who assert that the swallow migrates to a warmer country in winter, argue in this manner: That many birds migrate, is a fact fully proved by the observations of natural historians. Is it not more probable, therefore, that swallows, which disappear regularly every season, retire to some other country, than that they lie in a state of torpor in caverns or lakes? But this opinion does not rest on probability, it is founded on facts.

We often see them collected in great flocks on churches, rocks, and trees, about the time when they annually disappear. The direction of their flight has been observed to be southward. Mr White, the ingenious historian of Selborne, travelling near the coast of the British Channel one morning early, saw a flock of swallows take their departure. At the beginning of his journey he was environed with a thick fog; but on a large wild heath the mist began to break, and discovered to him numberless swallows, clustered on the standing bushes, as if they had roosted there: as soon as the sun burst out, they were instantly on wing, and with an easy and placid flight proceeded towards the sea. After this he saw no more flocks, only now and then a straggler. *Natural History of Selborne*, p. 64.

Mr Laskey of Exeter observed attentively the direction which a flock of swallows took in the autumn of 1793. On the 22d of Sept. about seven o'clock in the morning, the wind being easterly, accompanied with a cold drizzling rain, Mr Laskey's house was entirely covered with house-swallows. At intervals large flocks arrived and joined the main body, and at their arrival an unusual chirping commenced. The appearance of the whole company was so lethargic, that he found it an easy matter to catch a considerable number of them, which he kept in a room all that day. By heating the room they all revived: he opened four of them, and found their stomachs quite full. The main body occupied the house top all day, except for two hours. About half an hour after nine in the morning of the 23d, there was a great commotion, with very loud chirping, and within a few minutes after, the whole multitude took their flight, in a direct south-east direction, having ascended to a great height in the atmosphere. He let go the birds which he had caught, at certain intervals till four o'clock, and they all flew toward the same quarter. *Gent. Mag. for* 1796.

Not only has the direction of their flight been observed, but they have also been found on their passage at a great distance from land. Mr Adanson informs us, that about 50 leagues from the coast of Senegal four swallows settled upon the ship on the 6th of October; that

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that these birds were taken; and that he knew them to be European swallows, which, he conjectures, were returning to the coast of Africa. Sir Charles Wager's authority may also be appealed to: "Returning home (says he) in the spring of the year, as I came into soundings in our channel, a great flock of swallows came and settled on all my rigging; every rope was covered, they hung on one another like a swarm of bees; the decks and carving were filled with them. They seemed almost famished and spent, and were only feathers and bones; but, being recruited with a night's rest, took their flight in the morning." This vast fatigue proves that their journey must have been very great, considering the amazing swiftness of these birds: in all probability they had crossed the Atlantic ocean, and were returning from the shores of Senegal, or other parts of Africa; so that this account from that most able and honest seaman, confirms the later information of Mr Adanson.

Philosophical Transactions, vol. liii.

Mr Kalm, who is an advocate for the opinion that swallows lie immersed in lakes during winter, acknowledges that in crossing the Atlantic from Europe a swallow lighted on the ship on the 2d September, when it had passed only two-thirds of the ocean. Since, therefore, swallows have been seen assembled in great flocks in autumn flying off in company towards southern climes, since they have been found both in their passage from Europe and returning again, can there be any doubt of their annual migration?—Mr Barrington's objections to this opinion have been noticed above in N° 5.

Kalm's Voyage, vol. i. p. 24.

9 Second opinion, that some lie in caverns in a torpid state.

The second notion (says Mr Pennant) has great antiquity on its side. Aristotle and Pliny give it as their belief, that swallows do not remove very far from their summer habitation, but winter in the hollows of rocks, and during that time lose their feathers. The former part of their opinion has been adopted by several ingenious men; and of late several proofs have been brought of some species, at least, having been discovered in a torpid state. Mr Collinson favoured us with the evidence of three gentlemen, eye-witnesses to numbers of sand martins being drawn out of a cliff on the Rhine, in the month of March 1762. And the honourable Daines Barrington communicated to us the following fact, on the authority of Lord Belhaven, That numbers of swallows have been found in old dry walls and in sand-hills near his Lordship's seat in East Lothian; not once only, but from year to year; and that when they were exposed to the warmth of a fire, they revived. We have also heard of the same annual discoveries near Morpeth in Northumberland, but cannot speak of them with the same assurance as the two former: neither in the two last instances are we certain of the particular species.

Pennant's British Zoology, vol. ii. p. 250.

"Other witnesses crowd on us to prove the residence of those birds in a torpid state during the severe season. First, in the chalky cliffs of Sussex; as was seen on the fall of a great fragment some years ago. Secondly, In a decayed hollow tree that was cut down, near Dolgelli, in Merionethshire. Thirdly, In a cliff near Whitby, York-shire; where, on digging out a fox, whole bushels of swallows were found in a torpid condition. And, lastly, The reverend Mr Conway of Sychton, Flintshire, was so obliging as to communicate the following fact: A few years ago, on looking down an old lead-mine in that county, he observed numbers of swallows clinging to the timbers of the shaft, seemingly asleep; and on flinging some gravel on them, they just moved, but never attempted to fly or change their place: this was between All Saints and Christmas.

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"These are doubtless the lurking places of the later hatches, or of those young birds which are incapable of distant migrations. There they continue insensible and rigid; but like flies may sometimes be reanimated by an unseasonable hot day in the midst of winter: for very near Christmas a few appeared on the moulding of a window of Merton college, Oxford, in a remarkably warm nook, which prematurely set their blood in motion, having the same effect as laying them before a fire at the same time of year. Others have been known to make this premature appearance; but as soon as the cold natural to the season returns, they withdraw again to their former retreats.

"The above are circumstances we cannot but assent to, though seemingly contradictory to the common course of nature in regard to other birds. We must, therefore, divide our belief relating to these two so different opinions; and conclude, that one part of the swallow tribe migrate, and that others have their winter quarters near home. If it should be demanded, why swallows alone are found in a torpid state, and not the other many species of soft-billed birds, which likewise disappear about the same time? reasons might be assigned."

10 Third opinion, that some lie immersed in water

The third opinion we shall state and support in the words of Mr Kalm. "Natural history (says he), as all other histories, depends not always upon the intrinsic degree of probability, but upon facts founded on the testimony of people of noted veracity.—Swallows are seldom seen sinking down into water; swallows have not such organs as frogs or lizards, which are torpid during winter; *ergo*, swallows live not, and cannot live, under water.—This way of arguing, I believe, would carry us, in a great many cases, too far: for though it is not clear to every one, it may however be true; and lizards and frogs are animals of a class widely different from that of birds, and must therefore of course have a different structure; hence it is they are classed separately. The bear and marmot are in winter in a torpid state, and have, however, not such organs as lizards and frogs; and nobody doubts of their being, during some time, in the most rigid climates, in a torpid state: for the Alpine nations hunt the marmots frequently by digging their holes up; and find them so torpid, that they cut their throats, without their reviving or giving the least sign of life during the operation; but when the torpid marmot is brought into a warm room, and placed before the fire, it revives from its lethargy. The question must therefore be decided by facts; nor are these wanting here. Dr Wallerius, the celebrated Swedish chemist, informs us, That he has seen, more than once, swallows assembling on a reed, till they were all immersed and went to the bottom; this being preceded by a dirge of a quarter of an hour's length. He attests likewise, that he had seen a swallow caught during winter out of a lake with a net, drawn, as is common in northern countries, under the ice; this bird was brought into a warm room, revived, fluttered about, and soon after died.

"Mr Klein applied to many farmers-general of the

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"These are facts attested by people of the highest quality, by some in public offices, and by others who, though of a low rank, however, made these affidavits upon oath. It is impossible to suppose indiscriminately that they were prompted, by views of interest, to assert as a fact a thing which had no truth in it. It is therefore highly probable, or rather incontestably true, that swallows retire in the northern countries, during winter, into the water, and stay there in a torpid state till the return of warmth revives them again in spring. The question therefore, I believe, ought for the future to be thus stated: The swallows in Spain, Italy, France, and perhaps some from England, remove to warmer climates; some English ones, and some in Germany and other mild countries, retire into clefts and holes in rocks, and remain there in a torpid state. In the colder northern countries the swallows immerse in the sea, in lakes, and rivers; and remain in a torpid state, under ice, during winter. There are still some objections to this latter assertion, which we must remove. It is said, Why do not rapacious fish, and aquatic quadrupeds and birds, devour these swallows? The answer is obvious, swallows choose only such places in the water for their winter retreat as are near reeds and rushes; so that sinking down there between them and their roots, they are by them secured against the rapaciousness of their enemies. But others object, Why are not these birds caught in such fresh waters as are continually harassed by nets? I believe the same answer which has been made to the first objection will serve for this likewise. Fishermen take care to keep off with their nets from places filled with reeds and rushes, for fear of entangling and tearing their net; and thus the situation of swallows under water, is the reason that they are seldom disturbed in their silent winter retreats. What confirms this opinion still more is, that swallows were never caught in Prussia according to the above-mentioned affidavits, but with those parts of the net which passed near to the reeds and rushes; and sometimes the swallows were yet fastened with their feet to a reed, when they were drawn up by the net. As to the argument taken from their being so long under water without corruption, I believe there is a real difference between animals suffocated in water and animals being torpid therein. We have examples of things being a long time under water; to which we may add the intense cold of these northern regions, which preserves them. Who would have thought that snails and polypes might be dissected, and could reproduce the parts severed from their bodies, if it was not a fact? Natural history ought to be studied as a collection of facts, not as the history of our guesses or opinions. Nature varies in an infinite manner; and Providence has diversified the instinct of animals and their economy, and adapted it to the various seasons and climates."

With Mr Kalm's concluding observations we heartily concur. Natural history ought to be studied as a collection of facts; and it was from this very notion that we have stated the above-mentioned opinions so fully, and brought together the facts which the best advocates for each opinion have judged most proper for supporting

11
This question ought to be determined, not by reasoning, but by experiment.

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supporting them. We are sensible of the great improbability of the third opinion, and know that many arguments have been used to prove its absurdity: such as these, The swallow is lighter than water, and therefore cannot sink; if it moults at all, it must moult under water during its torpid state, which is very improbable; there is no instance of land animals living so long under water without respiration. Many other arguments of the same sort have been advanced, and certainly afford a short way of deciding the question; but unless they were sufficient to prove the immersion of swallows a physical impossibility, they are of no force when opposed to the evidence of testimony, if there be no cause to suspect the witnesses of inaccuracy or design. The true way to refute such an opiuion is by accurate observation and experiment. We have not heard of any accurate inquiries being made by philosophers in those northern countries where swallows are said to pass the winter under water. The count de Buffon, indeed, shut up some swallows in an ice-house by way of experiment, which died in a few days; but as he does not tell us what precautions he took to make the experiment succeed, it is not entitled to any attention.

Gentleman's Magazine, May 1796.

Mr John Hunter made a very judicious experiment on the banks of the Thames, which is described by a correspondent in the Gentleman's Magazine, who asserts that he had it from Mr Hunter himself.

12 Mr Hunter's experiment ingenious;

One year in the month of September, he prepared a room, with every accommodation and convenience which he could contrive, to serve as a dormitory for swallows, if they were disposed to sleep in winter. He placed in the centre a large tub of water with twigs and reeds, &c. which reached to the bottom. In the corners of the room he contrived artificial caverns and holes, into which they might retire; and he laid on the floor, or suspended in the air, different lengths of old wooden pipes, which had formerly been employed in conveying water through the streets, &c.

When the receptacle was rendered as complete as possible, he then engaged some watermen to take by night a large quantity of the swallows that hang upon the reeds in the Thames about the time of their departure. They brought him, in a hamper, a considerable number; and had so nicely hit the time of their capture, that on the very day following there were none to be seen.

He put the swallows into the room so prepared, where they continued to fly about, and occasionally perch on the twigs, &c. But not one ever retired into the water, the caverns, holes, or wooden pipes, or shewed the least disposition to grow torpid, &c. In this situation he let them remain till they all died but one. This appearing to retain some vigour, was set at liberty; when it mounted out of sight, and flew away. All the birds lay dead scattered about the room; but not one was found asleep or torpid, or had, if the correspondent remembers, so much as crept into any of the receptacles he had so provided.

13 but not decisive with respect to northern climates.

This experiment was ingenious, and certainly does render the doctrine of immersion much more improbable; but it is not decisive; for it may still be urged by the advocates for that doctrine, as Mr Kalm has done, that it may only be in the colder countries where swallows retire into the water. We formerly said that none of the three opinions is supported by such evidence as to satisfy the mind completely. Opinions respecting events which happen every year ought to be confirmed by a great number of observations, and not by a few instances divested of almost all their concomitant circumstances. Can no better proofs be brought to prove the migration of swallows than those of Adanson and Sir Charles Wager, or the circumstances mentioned by Mr White and Mr Laskey respecting their disappearing? We ought not merely to know that some swallows have taken a southerly flight in autumn, that some have been found at a great distance from land in the spring, or in harvest; but we ought to know to what countries they actually retire. Before we can rest satisfied, too, that it is a general fact that swallows remain in a torpid state during winter, either in caverns or in the bottom of lakes, &c. we must have more proofs; we must know what species of swallows they are said to be, in what countries this event takes place, and several other circumstances of the same kind.

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14 Many things yet remain to be done in order to determine this point.

We cannot help being of opinion that much remains to be done in order properly to ascertain what becomes of the swallows in Europe during winter. It would be necessary, in the first place, to know accurately what are the countries in which swallows are found. 2. Do they remain visible the whole year? or, if they disappear, at what season does this happen, and when do they appear again? 3. Do they ever appear while a strong north wind blows, or do they only come in great numbers with a south wind? We will endeavour to answer some of these questions in part; but must regret, that all the information on this subject which we have been able to cull from the best writers in natural history is very scanty; and we merely give it by way of specimen, hoping that future observations will render it more complete.

15 A few important facts stated.

There are five species which visit Britain during the summer months; the common or chimney swallow, the martin, sand martin, swift, and goat-sucker. 1. The chimney swallow frequents almost every part of the old continent; being known (says Dr Latham) from Norway to the Cape of Good Hope on the one side, and from Kamtschatka to India and Japan on the other. It is also found in all parts of North America, and in several of the West Indian islands. In Europe it disappears during the winter months. It appears generally a little after the vernal equinox; but rather earlier in the southern, and later in the northern latitudes. It adheres to the usual seasons with much regularity; for though the months of February and March should be uncommonly mild, and April and May remarkably cold, it never deviates from its ordinary time. In the cold spring of 1740 some appeared in France before the insects on which they feed had become numerous enough to support them, and great numbers died †. In the mild and even warm spring of 1774 they appeared no earlier than usual. They remain in some warm countries the whole year. Kolben assures us that this is the case at the Cape of Good Hope; but (he says) they are more numerous in winter. Some birds of this species live, during winter, even in Europe; for example on the coast of Genoa, where they spend the night in the open country on the orange shrubs.

† Buffon's Natural History of Birds, vol. vi. p. 5[illegible]

2. The

Migration. 2. The *martins* are also widely diffused through the old continent; but the countries where they reside or visit have not been marked by naturalists with much attention. 3. The *sand martins* are found in every part ‡ *Ibid.* 527. of Europe, and frequently spend the winter in Malta ‡. Two birds of this species were seen in Perigord in France, on the 27th December 1775, when there was ‖ *Ibid.* 484. a southerly wind, attended with a little rain ‖. 4. The *swift* visits the whole continent of Europe; has also been observed at the Cape of Good Hope, and in Carolina in North America. The *goat-suckers* are not very common birds, yet are widely scattered. They are found in every country between Sweden and Africa: they are found also in India. In April the south-west wind brings them to Malta, and in autumn they repass in great numbers.

Transactions of the Linnæan Society, vol. i. Mr Markwick of Catsfield, near Battle in Sussex, has drawn up an accurate table, expressing the day of the month on which the birds, commonly called *migratory*, appeared in spring, and disappeared in autumn, for 16 years, from 1768 to 1783 inclusive. The observations were made at Catsfield. From this table we shall extract the dates for five years, and add the very few observations which we have been able to collect respecting the time when the swallow appears and disappears in other countries.

	First seen.	*Last seen.*
	1779.	
Chimney Swallow	April 14.	October 29.
Martins	14.	15.
Sand Martin	May 7.	
Swift	9.	
	1780.	
Chimney Swallow		November 3.
Martins	April 29.	3.
Sand Martin	8.	September 8.
Swift	May 6.	8.
	1781.	
Chimney Swallow	April 8.	October 15.
Martins	May 12.	September 7.
Sand Martin	April 26.	September 1.
Swift	May 12.	1.
	1782.	
Chimney Swallow	April 22.	September 1.
Martins	26.	November 2.
Sand Martin	May 15.	August 28.
Swift	18.	28.
	1783.	
Chimney Swallow	April 13.	November 6.
Martins	May 1.	6.
Sand Martin	July 25.	September 1.
Swift	May 13.	November 6.

	Chim. Swal.	Swifts	Martins.	S Mart.
	Appear about			
† *Buffon*, ibid. In Burgundy †			Ap. 9.	Ap. 12.
In Selborne, Hampshire ‡	Ap. 4.	Ap. 24.	Ap 30.	
‡ *White's Natural History of Selborne.* In South Zele, Devonshire ‡	25.	May 1.	May 15.	
In Blackburn, Lancashire ‡	29.	Ap. 28.		
§ *Buffon*, ibid. In Upsal in Sweden §			May 9.	

Were tables of the same kind made in every different country, particularly within the torrid zone, it would be easy to determine the question which we have been considering. To many, perhaps, it may not appear a matter of such importance as to be worth the labour. We acknowledge it to be rather a curious than an important inquiry; yet it is one which must be highly gratifying to every mind that can admire the wisdom of the Great Architect of nature. The instinct of the swallow is indeed wonderful: it appears among us just at the time when insects become numerous; and it continues with us during the hot weather, in order to prevent them from multiplying too much. It disappears when these insects are no longer troublesome. It is never found in solitude; it is the friend of man, and always takes up its residence with us, that it may protect our houses and our streets from being annoyed with swarms of flies. Migration Miguel.

Migration of Fishes. See Clupea.

St MIGUEL, or St Michael, one of the Azore islands, situated in W. Long. 25. 45. N. Lat. 38. 10. This island appears to be entirely volcanic. The best account we have of it hath been published in the 68th volume of the Philosophical Transactions by Mr Francis Masson. According to him, the productions differ greatly from those of Madeira, insomuch that none of the trees of the latter are found here, except the faya: it has a nearer affinity to Europe than Africa. The mountains are covered with the erica vulgaris, and an elegant evergreen shrub very like a phillyrea, which gives them a most beautiful appearance.

It is one of the principal and most fertile of the Azorian islands, lying nearly east and west. Its length is about 18 or 20 leagues; its breadth unequal, not exceeding five leagues, and in some places not more than two. It contains about 80,000 inhabitants.

Its capital, the city of Ponta del Guda, which contains about 12,000 inhabitants, is situated on the south side of the island, on a fine fertile plain country, pretty regularly built; the streets straight, and of a good breadth. It is supplied with good water, which is brought about the distance of three leagues from the neighbouring mountains. The churches and other religious edifices are elegant and well built for such an island. There is a large convent of Franciscan friars and one of the order of St Augustine, four convents for professed nuns, and three Ricolhimentos for young women and widows who are not professed. The vessels anchor in an open road; but it is not dangerous, as no wind can prevent their going to sea in case of stormy weather.

The country round the city is plain for several miles, well cultivated, and laid out with good taste into spacious fields, which are sown with wheat, barley, Indian corn, pulse, &c. and commonly produce annually two crops; for as soon as one is taken off, another is immediately sown in its place. The soil is remarkably gentle and easy to work, being for the most part composed of pulverized pumice stone. There are in the plains a number of pleasant country seats, with orchards of orange trees, which are esteemed the best in Europe.

The second town is Ribeira Grande, situated on the north side of the island, containing about as many inhabitants as the city; a large convent of Franciscan friars, and one of nuns. It gives title to a count, called the *Conde Ribeira Grande*, who first instituted linen and woollen manufactories in the island.

The third town is Villa Franca, on the south side of the island, about six leagues east of Ponta del Guda.

Miguel. It has a convent of Franciscan friars and one of nuns, which contains about 300. Here, about half a mile from the shore, lies a small island (Ilhao), which is hollow in the middle, and contains a fine bason with only one entrance into it, fit to hold 50 sail of vessels secure from all weather; at present it wants cleaning out, as the winter rain washes down great quantities of earth into it, which has greatly diminished its depth. But vessels frequently anchor between this island and the main.

Besides these towns are several smaller, viz. Alagao, Agoa de Pao, Brelanha, Fanaes de Ajuda, and a number of hamlets, called *lugars* or *places*.

About four leagues north-east from Villa Franca, lies a place called the Furnas, being a round deep valley in the middle of the east part of the island, surrounded with high mountains, which, though steep, may be easily ascended on horseback by two roads. The valley is about five or six leagues in circuit. The face of the mountains, which are very steep, is entirely covered with beautiful evergreens, viz. myrtles, laurels, a large species of bilberry called *uva de serra*, &c. and numberless rivulets of the purest water run down their sides. The valley below is well cultivated, producing wheat, Indian corn, flax, &c. The fields are planted round with a beautiful sort of poplars, which grow into pyramidal forms, and by their careless irregular disposition, together with multitude of rivulets, which run in all directions through the valley, a number of boiling fountains throwing up clouds of steam, a fine lake in the south-west part about two leagues round, compose a prospect the finest that can be imagined. In the bottom of the valley the roads are smooth and easy, there being no rocks, but a fine pulverized pumice stone that the earth is composed of.

There are numerous hot fountains in different parts of the valley, and also on the sides of the mountains: but the most remarkable is that called the *chaldeira*, situated in the eastern part of the valley, on a small eminence by the side of a river, on which is a bason about 30 feet diameter, where the water continually boils with prodigious fury. A few yards distant from it is a cavern in the side of the bank, in which the water boils in a dreadful manner, throwing out a thick, muddy, unctuous water, several yards from its mouth with a hideous noise. In the middle of the river are several places where the water boils up so hot, that a person cannot dip his finger into it without being scalded; also along its banks are several apertures, out of which the steam rises to a considerable height, so hot that there is no approaching it with one's hand: in other places, a person would think that 100 smiths bellows were blowing altogether, and sulphureous steams issuing out in thousands of places; so that native sulphur is found in every chink, and the ground covered with it like hoar frost; even the bushes that happen to lie near these places are covered with pure brimstone, condensing from the steam that issues out of the ground, which in many places is covered over with a substance like burnt alum. In these small caverns from which the steam issues, the people often boil their yams.

Near these boiling fountains are several mineral springs; two in particular, whose waters have a very strong quality, of an acid taste, and bitter to the tongue. Miguel.

About half a mile to the westward, and close by the river side, are several hot springs, which are used by sick people with great success. Also, on the side of a hill west of St Anne's church, are many others, with three bathing houses, which are most commonly used. These waters are very warm, although not boiling hot; but at the same place issue several streams of cold mineral water, by which they are tempered, according to every one's liking.

About a mile south of this place, and over a low ridge of hills lies a fine lake about two leagues in circumference, and very deep, the water thick, and of a greenish colour. At the north end is a plain piece of ground, where the sulphurous steams issue out in many places, attended with a surprising blowing noise. Our author could observe strong springs in the lake, but could not determine whether they were hot or cold: this lake seems to have no visible evacuation. The other springs immediately form a considerable river, called *Ribeira Quente*, which runs a course about two or three leagues, through a deep rent in the mountains, on each side of which are several places where the smoke issues out. It discharges itself into the sea on the south side, near which are some places where the water boils up at some distance in the sea.

This wonderful place had been taken little notice of until very lately: so little curiosity had the gentlemen of the island, that scarcely any of them had seen it, until of late some persons, afflicted with very virulent disorders, were persuaded to try its waters, and found immediate relief from them. Since that time it has become more and more frequented; several persons who had lost the use of their limbs by the dead palsy have been cured; and also others who were troubled with eruptions on their bodies.

A clergyman, who was greatly afflicted with the gout, tried the said waters, and was in a short time perfectly cured, and has had no return of it since. When Mr Masson was there, several old gentlemen, who were quite worn out with the said disorder, were using the waters, and had received incredible benefit from them; in particular, an old gentleman about 60 years of age, who had been tormented with that disorder more than 20 years, and often confined to his bed for six months together: he had used these waters for about three weeks, had quite recovered the use of his limbs, and walked about in the greatest spirits imaginable. A friar also who had been troubled with the said disorder about 12 years and reduced to a cripple, by using them a short time was quite well, and went a-hunting every day.

There are several other hot springs in the island, particularly at Ribeira Grand; but they do not possess the same virtues, at least not in so great a degree.

The east and west part of the island rises into high mountains; but the middle is low, interspersed with round conic hills, all of which have very recent marks of fire; all the part below the surface consisting of melted lava lying very hollow.

Most of the mountains to the westward have their tops hollowed out like a punch bowl, and contain wa-

ter.

Miguel, Milan.

ter. Near the west end is an immense deep valley like the Furnas, called the *Sete Cidades*. This valley is surrounded with very abrupt mountains, about seven or eight leagues round; in the bottom is a deep lake of water about three leagues in circuit, furnished with great numbers of water fowls. This water has no mineral quality; neither are there any hot springs in the valley. All these mountains are composed of a white crumbly pumice stone, which is so loose, that if a person thrust a stick into the banks, whole waggon loads of it will tumble down. The inhabitants of the island relate a story, that he who first discovered it observed an extraordinary high peak near the west end; but the second time he visited it, no such peak was to be seen, which he supposed must have certainly sunk; but, however improbable this story may be, at some period or other it must have certainly been the case. See AZORES, SUPPLEMENT.

MILAN, or the duchy of the Milanese, a country of Italy, bounded on the west by Savoy, Piedmont, and Montferrat; by Switzerland on the north; by the territories of Venice, the duchies of Mantua, Parma, and Placentia on the east; and by the territories of Genoa on the south. It is 150 miles long, and 78 broad.

Anciently this duchy, containing the north part of the old Liguria, was called *Insubria*, from its inhabitants the *Insubres;* who were conquered by the Romans, as these were by the Goths; who in their turn were subdued by the Lombards. Didier, the last king of the Lombards, was taken prisoner by Charlemagne, who put an end to the Longobardic empire, and appointed governors of Milan. These governors being at a distance from their masters, soon began to assume an independency, which brought a dreadful calamity on the country; for, in 1152, the capital itself was levelled with the ground by the emperor Frederic Barbarossa, who committed great devastations otherwise throughout the duchy. Under this emperor lived one Galvian, a nobleman who was descended from Otho a Milanese. Galvian, along with William prince of Montferrat, served in the crusade, when Godfrey of Boulogne took Jerusalem: he killed in single combat the Saracen general, whom he stripped of his helmet, which was adorned with the image of a serpent swallowing a youth; and this ever afterwards was the badge of that family. His grandson Galvian, having opposed the emperor, was taken prisoner, and carried in irons into Germany, from whence he made his escape, and returning to Milan, died in the service of his country. From him descended another Otho, at the time that Otho IV. was emperor of Germany, and who soon distinguished himself by the accomplishments both of his mind and body. When he grew up, he was received into the family of Cardinal Octavian Ubaldini at Rome. This prelate, who was himself aspiring at the popedom, was in a short time greatly taken with the address and accomplishments of young Otho, and predicted his future greatness. In the mean time, one Torres, or Torriano, a Milanese nobleman of unbounded ambition, was attempting to make himself master of Milan. The popular faction had some time before been caballing against the nobility; and at last, Torriano putting himself at their head, expelled the bishop, and put to death or banished all the nobility; by which means the popular government was fully established; and Torriano, under this pretence, ruled every thing as he pleased. He was, however, soon opposed by one Francisco Sepri, who formed a great party, pretending to deliver the city from Torriano's haughtiness and cruelty. But while the two parties were collecting their forces against each other, Cardinal Ubaldini was projecting the destruction of both, by means of his favourite Otho. This prelate had for some time borne an implacable hatred to Torriano, because he had been by him prevented from carrying out of the treasury of St Ambrose's church at Milan, a carbuncle or jewel of great value, which he pretended to reserve for adorning the papal tiara; for which reason he now determined to oppose his ambition. Milan.

Ubaldini began with naming Otho archbishop of Milan; which, as the pope's legate, he had a right to do. This nomination was confirmed by Pope Urban IV.; and the party of the nobility having now got a head from the pope himself, began to gather strength. Otho in the mean time employed himself in collecting troops; and had no sooner procured a show of an army than he advanced towards Lago Maggiore, and took possession of Arona, a strong post near that lake: but Torriano, marching immediately against him with all his troops, obliged him to abandon the place, and leave his party to make the best terms they could with the conqueror. This was followed by the destruction of the castles of Arona, Anghiari, and Brebia: soon after which Torriano died, and was succeeded by his brother Philip, who had sufficient interest to get himself elected podesta, or prætor of Milan, for ten years. During his lifetime, however, the party of the nobility increased considerably under Otho, notwithstanding the check they had received. Philip died in 1265, having lost ground considerably in the affections of the people, though he obtained a great reputation for his courage and conduct. His successor Napi rendered himself terrible to the nobility, whom he proscribed, and put to death as often as he could get them into his power. He proceeded such lengths, and acted with such fury against that unfortunate party, that Pope Clement IV. who had succeeded Urban, at last interdicted Milan, and excommunicated Napi and all his party. By this Napi began to lose his popularity, and the public disaffection towards him was much heightened by the natural cruelty of his temper. But in the mean time, the party of the nobility was in the utmost distress. Otho himself and his friends, having spent all their substance, wandered about from place to place; the pope not being in a capacity of giving them any assistance. Otho, however, was not discouraged by his bad success, but found means still to keep up the spirits of his party, who now chose for their general Squarcini Burii, a man of great eminence and courage, whose daughter was married to Matthew Visconti, afterwards called *Matthew the Great*. At the same time they renewed their confederacy with the marquis of Montferrat, who was son-in-law to the king of Spain. The marquis agreed to this confederacy chiefly with a view to become master of the Milanese.

The nobility now again began to make head; and having collected an army, which was joined by 600 Spanish

Milan. Spanish cavalry and a body of foot, gained some advantages. But in the mean time Napi, having gathered together a superior army, suddenly attacked Otho and Burri, and defeated them. After this disaster Otho applied to the pope; from whom, however, he did not obtain the assistance he desired; and in the mean time Napi invited the emperor Rodolph into Italy, with the promise of being crowned at Milan. This invitation was accepted of with great readiness by Rodolph; who constituted Napi his governor and vicar-general in Lombardy, sending to him at the same time a fine body of German horse, the command of which was given to Cassoni, Napi's nephew. On this Otho again applied to the pope (Gregory X.); but he was so far from granting him any assistance, that he is said to have entered into a scheme of assassinating him privately; but Otho escaped the danger, and in 1276 began to recover his affairs. The reason of Pope Gregory's enmity to him was, that he and his party were thought to be Gibelines, and were opposed by great numbers of the nobility themselves; but after that pope's death, the Milanese exiles being united under one head, soon became formidable. They now chose for their general Godfrey count of Langusio, a noble Pavian, and an inveterate enemy of the Torriano family. This nobleman being rich and powerful, enlisted many German and other mercenaries, at whose head he marched towards the Lago Maggiore. All the towns in that country opened their gates to him, through the interest of the Visconti family, who resided in these parts. But this success soon met with a severe check in an unfortunate engagement, where Godfrey was defeated and taken prisoner; after which he and 34 nobles had their heads struck off, and sent from the field of battle piled up in a common waggon.

This defeat greatly affected Otho; but having in a short time recovered himself, he again attacked his enemies, and defeated them; but, suffering his troops to grow remiss after their victory, the fugitives rallied, and entirely defeated him. The next year, however, Otho had better success, and totally defeated and took prisoner Napi himself. After this victory Cassoni was obliged to abandon Milan to his competitor, who kept possession of it till his death, which happened in 1295, in the 87th year of his age.

Otho was succeeded by Matthew Visconti above mentioned; and Milan continued in subjection to that family without any very memorable occurrence till the year 1378, when, by the death of Galeazzo II. his brother Barnabo became sovereign of Milan. He was of a brave and active disposition; but excessively profuse in his expenses, as his brother Galeazzo had also been; and to procure money to supply his extravagancies, was obliged to oppress his subjects. Galeazzo had engaged in an enterprize against Bologna, and the siege of it was continued by Barnabo. It lasted for nine years; and during this time is said to have cost 300 millions of gold, a prodigious sum in those days, near 40 millions sterling, the lowest gold coin being in value somewhat more than half a crown English. Both the brothers were excessively fond of building. Barnabo erected a bridge over the Adda, consisting of three stories; the lowest for chariots and heavy carriages, the middle for horses, and the uppermost for foot passengers. He built also another bridge which was carried over houses without touching them. To accomplish these, and many other expensive schemes, he became one of the greatest tyrants imaginable, and every day produced fresh instances of his rapacity and cruelty. He instituted a chamber of inquiry, for punishing all those who had for five years before been guilty of killing boars, or even of eating them at the table of another. They who could not redeem themselves by money were hanged, and above 100 wretches perished in that manner. Those who had any thing to lose were stripped of all their substance, and obliged to labour at the fortifications and other public works. He obliged his subjects to maintain a great many hunting dogs, and each district was taxed a certain number. The overseers of his dogs were at the same time the instruments of his rapacity. When the dogs were poor and slender, the owners were always fined; but when the dogs were fat, the owners were also fined for suffering them to live without exercise. Milan

The extravagant behaviour of Barnabo soon rendered public affairs ready for a revolution, which was at last accomplished by his nephew John Galeazzo. He affected a solitary life, void of ambition, and even inclining to devotion; but at the same time took care to have his uncle's court filled with spies, who gave him information of all that passed. He reduced his table and manner of living, pretending that he took these steps as preparatives to a retirement from the world, which was soon to take place after he had paid a religious vow. In short, he acted his part so well, that even Barnabo, though abundantly cautious, had no suspicion of his having any designs against him; and so entirely did he conceal his ambition, that he several times made application to his uncle for his interest to procure him a quiet retreat as soon as his religious vows were performed. One of these was to pay a visit to the church of the blessed Virgin upon Mount Varezzio. This was to be done with so much secrecy that all kinds of eye witnesses were to be excluded; and it was with difficulty that Barnabo himself and two of his sons were allowed to accompany our devotee. But, in the mean time, the hypocritical Galeazzo had soldiers advancing from all quarters; so that Barnabo and his sons were immediately seized, and the houses of those who had sided with them given up to be plundered. The booty in plate, money, and all kinds of rich furniture, was immense. The ministers of the late government were dragged from their hiding places, and put to death; and at last the citadel itself fell into the hands of Galeazzo, who found in it an immense sum of money. Barnabo was carried prisoner to Tritici, a castle of his own building, where he had the happiness to find one person still faithful to him. This was his mistress, named *Doninia Porra*; who, when he was abandoned by all the world, shut herself up a voluntary prisoner in his chamber, and remained with him as long as he lived, which was only seven months after his degradation.

John Galeazzo was the first who took upon him the title of the *Duke of Milan*, and was a prince of great policy and no less ambition. He made war with the Florentines, became master of Pisa and Bologna, and entirely defeated the emperor in 1401, so that he entertained hopes of becoming master of all Lombardy, and cutting off all possibility of invading it either from

Milan. France or Germany; but his designs were frustrated by death, which happened in 1402, in the 55th year of his age. After his decease the Milanese government fell into the most violent distractions, so that it could not be supported, even in time of peace, without an army of 20,000 foot and as many horse. In the year 1421, however, Philip duke of Milan became master of Genoa; but though he gained great advantages in all parts of Italy, the different states still found means to counterbalance his successes, and prevent him from enslaving them: so that Milan never became the capital of any extensive empire; and in 1437 Genoa revolted, and was never afterwards reduced.

Philip died in 1448, and by his death the male line of the Visconti family was at an end. The next lawful heir was Valentina his sister, who had married the duke of Orleans, son to Charles V. of France. By the contract of that marriage, the lawful progeny of it was to succeed to the duchy of Milan in failure of the heirs male of the Visconti family; but this succession was disputed by Sforza, who had married Philip's natural daughter. It is certain, however, that the rightful succession was vested in the house of Orleans and the kings of France; and therefore though the Sforza family got possession of the duchy for the present, Louis XII. afterwards put in his claim, being a grandson to John Galeazzo. For some time he was successful; but the French behaved in such an insolent manner, that they were driven out of the Milanese by the Swiss and Maximilian Sforza. The Swiss and Milanese were in their turn expelled by Francis I. who obliged the Sforza family to relinquish the government for a pension of 30,000 ducats a-year. Francis Sforza, the son of Maximilian, however, being assisted by the emperor and the pope, regained the possession of the Milanese about the year 1521; and, eight years after, the French king, by the treaty of Cambray, gave up his claim on the duchy.

But, in fact, the emperors of Germany seem to have had the fairest title to the Milanese in right of their being for a long time sovereigns of Italy. On the death of Francis Sforza, therefore, in the year 1536, the emperor Charles V. declared the Milanese to be an imperial fief, and granted the investiture of it to his son Philip II. king of Spain. In his family it continued till the year 1706, when the French and Spaniards were driven out by the Imperialists, and the emperor again took possession of it as a fief. It was confirmed to his house by the treaty of Baden in 1714, by the quadruple alliance in 1718, and by the treaty of Aix-la-Chapelle in 1748.

The duchy of Milan is one of the finest provinces in Italy. It is bounded on the south by the Apennine mountains, and the territory of Genoa; on the north by Switzerland; on the east by the Venetian territories, and the duchies of Mantua, Parma, and Placentia; and on the west by Savoy, Piedmont, and Montferrat; extending from north to south about 100 miles, and from east to west about 108. It is well watered by the Tessino, the Sesia, the Adda, the Po, the Oglio, the Lombro, Serio, &c. and also by several canals and lakes. Of the latter, the Lago Maggiore is between 30 and 40 miles in length, and in some places six or seven miles broad. In it lie the *Boromean islands*, as they are called, viz. Isola Bella and Isola Madre, the beauty of which almost exceeds imagination: art and nature seem to have vied with one another in embellishing them. In each of them is a palace with delicious gardens, belonging to the Boromean family. The water of the lake is clear and of a greenish colour, and abounds with fish. The hills with which it is surrounded present a most charming landscape, being planted with vines and chesnut trees, interspersed with summer houses. There is a canal running from it towards Switzerland, with which the city of Milan has a communication. It was anciently called *Lacus Verbanus*. The Lago de Como, which was called by the Latin poets *Lacus Larius*, but had its modern name from the city near which it lies, extends itself about 30 miles northward from Como, but its greatest breadth is not above five miles. From the Lago Maggiore issues the Tessino; and from that of Como the Adda. Of the other lakes, that of Lugano and Guarda are the chief: that of Guarda was anciently called *Benacus*. Milan.

The trade and manufactures of this duchy consist principally in silk stuffs, stockings, gloves, and handkerchiefs, linen and woollen cloth, hardware, curious works of crystal, agate, hyacinths, and other gems; but their exports are usually far short of their imports. It produces also abundance of rice, corn, fruit, wine, and hemp. Great quantities of cheese are also made here.

In the year 1767, the Austrian government of Milan published a law, by which all the rights which the pope or the bishops had till then exercised over ecclesiastics, either with regard to their effects or persons, was transferred to a council established for that purpose at Milan. By the same edict, all ecclesiastics were obliged to sell the estates which they had become possessed of since the year 1722; and no subject, whether ecclesiastic or secular, was to go to Rome to solicit any favour, except letters of indulgence, without the consent of the said council.

This duchy was subdued by the French in the year 1796, when it formed a part of the Cisalpine republic. When hostilities recommenced in 1799, it was again taken by the allies, but afterwards reconquered by Bonaparte in 1800. From this period it formed a part of the kingdom of Italy, till the overthrow of Bonaparte's government in 1814, when it was restored to Austria with the rest of Lombardy.

Milan, the capital of the duchy of that name, in Latin *Mediolanum*, is a large city, and has a wall and rampart round it, with a citadel; yet is thought to be incapable of making any great resistance. The gardens within the city take up a great deal of ground. In the citadel is a foundery for cannon, and an arsenal furnished with arms for 12,000 men. Milan hath experienced a great variety of fortune, having been subject sometimes to the French, sometimes to the Spaniards, and sometimes to the Germans. A great number of persons of rank and fortune live in it, especially during the winter. The ladies in France are not allowed more liberty than those of this city: even the austerities of the monastic life are so far mitigated here, that gentlemen have not only the liberty of talking with the nuns, and of rallying and laughing at the grate, but also of joining with them in concerts of music, and of spending whole afternoons in

Milan. in their company. The place where the *beau monde* take the air, either in their coaches or on foot, is the rampart betwixt the Porta Orientale and the Porta Tosa, where it is straight and broad, and extremely pleasant, being planted with white mulberry trees, and commanding a prospect on one side of the open country, and on the other of the gardens and vineyards between the ramparts and the city. Milan, which is said to have been built by the Gauls about 200 years after the foundation of Rome, contains a great number of stately edifices, as churches, convents, palaces, and hospitals. The cathedral is a vast pile, all of marble; and is the largest in Italy, except that of St Peters at Rome. It is 449 feet in length, 275 in breadth, and 238 in height, under the cupola. Though founded in 1386, the façade was only completed a few years ago by order of Bonaparte. Of the great number of statues about it, that of St Bartholomew, just flead alive, with his skin hanging over his shoulders; and of Adam and Eve, over the main portal, are the finest. The pillars supporting the roof of the church are all of marble, and the windows finely painted. This church contains a treasure of great value, particularly a shrine of rock crystal, in which the body of St Charles Boromæo is deposited. The other churches most worthy a stranger's notice are those of St Alexander, St Jerome, St Giovanni di Casarotti della Passione, that of the Jesuits, and of St Ambrose, in which lie the bodies of the saint and of the kings Pepin and Bernard. In the Ambrosian college, founded by Frederic Boromæo, 16 professors teach gratis. In the same college is also an academy of painting, with a museum, and a library containing about 45,000 printed books and manuscripts; among the last of which is a translation of Josephus's History of the Jews, done by Rufinus about 1200 years ago, and written on the bark of a tree; St Ambrose's works on vellum, finely illuminated; the orations of Gregory Nazianzen, and the works of Virgil, in folio, with Petrarch's notes. In the museum are Leonardi da Vinci's mathematical and mechanical drawings, in 12 large volumes. The seminary for sciences, the college of the nobles, the Helvetian college, and the mathematical academy, are noble foundations, and stately buildings. Of the hospitals, the most remarkable are the Lazaretto, and that called the *great hospital;* the latter of which receives sick persons, foundlings, and lunaties, and has six smaller hospitals depending on it, with a revenue of 100,000 rix dollars.

The number of the inhabitants of this city is said to be about 130,000. It has been 40 times besieged, taken 20 times, and four times almost entirely demolished; yet it hath always recovered itself. It is said that gunpowder is sold here only by one person, and in one place. The houses of entertainment, and the ordinaries here, are represented as very indifferent.—Mr Keysler says, it is not unusual for young travellers, when they go to any of the taverns in Milan, to be asked, "whether they choose a *letto fornito*, or female bedfellow," who continues masked till she enters the bedchamber. Milan is described as inferior to Turin both in beauty and convenience, many of the streets being crooked and narrow, and paper windows much more frequent than in that city; even in grand palaces, the windows are often composed promiscuously of glass and paper. There are four theatres in the city: the great theatre Della Scala, built in 1778; that of the Canobiana, the theatre Re; and the Carcano. On the right of the Place d'Armes is a magnificent amphitheatre, appropriated to horsemanship and games, erected during the French rule. Two large canals extend from hence, the one to the Tessino, and the other to the Adda; the Tessino having a communication with the Lago Maggiore, and, by a canal, with the Sesia; and the Adda issuing from the Lago di Como, and having a communication by canals with the Lombro and Serio. In a void space in one of the streets of Milan, where stood the house of a barber who had conspired with the commissary of health to poison his fellow citizens, is erected a pillar called *Colonna Infame*, with an inscription to perpetuate the memory of the execrable design. The environs of this city are very pleasant, being adorned with beautiful seats, gardens, orchards, &c. About two Italian miles from it, at the seat of the Simonetti family, is a building, that would have been a masterpiece of its kind had the architect designed it for an artificial echo. It will return or repeat the report of a pistol above 60 times; and any single musical instrument well touched will have the same effect as a great number of instruments, and produce a most surprising and delightful concert. Milan.

Bonaparte was crowned king of Italy in this city in May 1805, and it was visited by the emperor of Austria in 1816. It is now the capital of the kingdom of Venetian Lombardy.

According to Dr Moore, "there is no place in Italy, perhaps in Europe, where strangers are received in such an easy hospitable manner as at Milan. Formerly the Milanese nobility displayed a degree of splendour and magnificence, not only in their entertainments, but in their usual style of living, unknown in any other country of Europe. They are under a necessity at present of living at less expence, but they still show the same obliging and hospitable disposition. This country having, not very long since, been possessed by the French, from whom it devolved to the Spaniards, and from them to the Germans, the troops of those nations have, at different periods, had their residence here, and in the course of these vicissitudes, produced a style of manners, and stamped a character on the inhabitants of this duchy, different from what prevails in any other part of Italy; and nice observers imagine they perceive in Milanese manners, the politeness, formality, and honesty imputed to those three nations, blended with the ingenuity natural to Italians. In Italy, the ladies have no notion of quitting their carriages at the public walks, and using their own legs as in England and France. On seeing the number of servants, and the splendour of the equipages which appear every evening at the Corso on the ramparts, one would not suspect that degree of depopulation, and diminution of wealth, which we are assured has taken place within these few years all over the Milanese; and which proceeds from the burdensome nature of some late taxes, and the insolent and oppressive manner in which they are gathered."—Milan is situated 29 leagues N. E. of Turin, 110 N. W. of Rome, and 143 S. E. of Paris.—E. Long. 9. 11. N. Lat. 45. 28.

Milan || Mildew.

MILBORN-PORT, a town of Somersetshire in England, seated on a branch of the river Parret, 115 miles from London. Though represented in parliament, it is no market town nor corporation; but it appears in Domesday-book to have had a market once, and 56 burgesses. It is in a manner surrounded by Dorsetshire. Here are nine capital burgesses, who yearly choose two bailiffs, that have the government of the borough under them, and jointly return the members to parliament with the two stewards, who are chosen yearly out of nine commonalty stewards, and have the custody of the corporation-seal. These two stewards also distribute the profits of the lands given to the poor here, of which the said commonalty stewards are trustees. The number of inhabitants in 1811 was 1000, of houses 230. W. Long. 2. 37. N. Lat. 50. 50.

MILBROOK, a town of Cornwall, on the west side of Plymouth haven. It has a good fishing trade, and has formerly furnished our fleet with many able hands.

MILDENHALL, a town of Suffolk, seven miles from Newmarket, 12 from Bury, and 70 from London. It is situated on the river Lark, a branch of the Ouse, with a harbour for boats, and contained in 1811, 2493 inhabitants. It has a well frequented market on Fridays. Its church has a tower or steeple 120 feet high. E. Long. 0. 33. N. Lat. 52. 24.

MILDEW, is said to be a kind of thick, clammy, sweet juice, exhaled from, or falling down upon, the leaves and blossoms of plants. By its thickness and clamminess it prevents perspiration, and hinders the growth of the plant. It sometimes rests on the leaves of trees in form of a fatty juice, and sometimes on the ears of corn. It is naturally very tough and viscous, and becomes still more so by the sun's heat exhaling its more fluid parts; by which means the young ears of corn are so daubed over, that they can never arrive at their full growth. Bearded wheat is less subject to the mildew than the common sort; and it is observed that newly dunged lands are more liable to mildew than others. The best remedy is a smart shower of rain, and immediately afterwards a brisk wind. If the mildew is seen before the sun has much power, it has been recommended to send two men into the field with a long cord, each holding one end; and drawing this along the field through the ears, the dew will be dislodged from them, before the heat of the sun is able to dry it to that viscous state in which it does the mischief. Some also say, that lands which have for many years been subject to mildews, have been cured of it by sowing soot along with the corn, or immediately after it.

Mr J. S. Segar, the author of a treatise upon this subject, observes, that the mildew is of such a sharp corrosive nature, that it raises blisters on the feet of the shepherds who go barefoot, and even consumes the hoofs of the cattle. He suspects that it possesses some arsenical qualities, though he does not pretend to affirm this positively. Its pernicious influence, according to him, is rendered still more powerful by a variety of circumstances; such as sending the cattle into the fields too early in the spring; their drinking water mixed with ice, or but lately thawed; their being kept in stables that are too close and filthy, and which are not sufficiently aired. The same author considers the mildew as a principal cause of epidemical distempers among the cattle. The mildew producing these diseases, he says, is that which dries and burns the grass and leaves. It falls usually in the morning, particularly after a thunder storm. Its poisonous quality (which does not continue above 24 hours) never operates but when it has been swallowed immediately after its falling. The disorder attacks the stomach, is accompanied with pimples on the tongue, loss of appetite, a desiccation of the aliments in the stomach, a cough, and difficulty of respiration. As a preservative, the author prescribes purging in spring and in winter. The medicine he advises is composed of 30 grains of sulphur of antimony, and 60 grains of resin of jalap. He is against vomiting, and every thing that is of a heating nature.

Mildew || Miletus.

MILE, a measure of length or distance, containing eight furlongs. The English statute mile is 80 chains, or 1760 yards; that is, 5280 feet.

We shall here give a table of the miles in use among the principal nations of Europe, in geometrical paces, 60,000 of which make a degree of the equator.

	Geometrical paces.
Mile of Russia	750
of Italy	1000
of England	1200
of Scotland and Ireland	1500
Old league of France	1500
The small league, *ibid.*	2000
The mean league, *ibid.*	2500
The great league, *ibid.*	3000
Mile of Poland	3000
of Spain	3428
of Germany	4000
of Sweden	5000
of Denmark	5000
of Hungary	6000

MILETUS, in *Ancient Geography*, a town of Crete mentioned by Homer; but where situated does not appear. It is said to be the mother town of Miletus in Caria, whither a colony was led by Sarpedon, Minos's brother, (Ephorus, quoted by Strabo). *Milesii*, the people, (Ovid).

MILETUS, in *Ancient Geography*, a celebrated town of Asia Minor, on the confines of Ionia and Caria. It was the capital city of all Ionia, and famous both for the arts of war and peace. It was situated about 10 stadia south of the mouth of the river Mæander, near the sea coast. It was founded by a Cretan colony under Miletus, the companion of Bacchus; or (according to others) by Neleus the son of Codrus; or by Sarpedon a son of Jupiter. It has successively been called *Lelegeis*, *Pithyusa*, and *Anactoria*. The inhabitants, called *Milesii*, were very powerful, and long maintained an obstinate war against the kings of Lydia. They early applied themselves to navigation; and planted no less than 80 colonies, or (according to Seneca) 380, in different parts of the world. It was the only town that made head against Alexander, and was with much difficulty taken. It gave birth to Thales,

Miletus || Milford.

Thales, one of the seven wise men, and the first who applied himself to the study of nature. It was also the country of Anaximander, the scholar and successor of Thales, the inventor of sun dials and the gnomon, and the first that published a geographical map; of Anaximenes, scholar and successor to the foregoing; and of other great men. It was noted for its excellent wool, according to Virgil; and was also celebrated for a temple and oracle of Apollo Didymæus. This famous people, from being powerful, becoming afterwards opulent and abandoned to pleasures, lost both their riches and their power.—At present it is called by the Turks *Melas*, and not far distant from it runs the river Mæander. St Paul going from Corinth to Jerusalem passed by Miletus, and as he went by sea, and could not take Ephesus in his way, he caused the bishops and priests of the church of Ephesus to come to Miletus (Acts xx. 15. &c.), which was about 12 leagues from them.

MILFOIL, or YARROW. See ACHILLEA, BOTANY *Index*.

MILFORD, a town of North America, in Sussex county, in the Delaware state, is situated at the source of a small river, 15 miles from Delaware bay, and 150 southward of Philadelphia. This town, which contains about 80 houses, has been built, except one house, since the revolution. It is laid out with much taste, and is by no means disagreeable. The inhabitants are Episcopalians, Quakers, and Methodists.

MILFORD Haven, one of the finest harbours in Europe, and indisputably the best in Britain, is situated in Pembrokeshire in South Wales, and lies on the north side of the Bristol channel. It is very large, safe, and deep; there is no danger of going in or out with the tide, or almost with any wind. If a ship comes in without a cable or anchor, she may run ashore on the ooze, and there lie safe till she is refitted; and in an hour's time she may get out of the harbour into the open sea. It lies extremely convenient for ships bound from the English or Bristol channels to Ireland, or farther west, and from thence to the channels. It is said, that 1000 sail of any size may ride secure in this haven. It has 16 deep and safe creeks, five bays, and 13 roads, all distinguished by their several names. The spring tide rises 36 feet, so that ships may at any time be laid ashore. Dale harbour is a ready outlet for small vessels, where they may ride in two or three fathoms at low water.—In the reign of Queen Elizabeth, before the Spanish invasion, two forts were begun at the entrance of Milford Haven, one on each side, called *Nangle* and *Dale* blockhouses; but they were not then finished.—The Stack rock rises here above water, lying near the middle of the entrance between Nangle and Dale. Penermouth is the opening of that branch of the haven on which the town of Pembroke is seated, and where the customhouse of Milford is kept. The breadth of the entrance between rock and rock is but 200 yards at high water, and 112 at low water. There is a ridge of rocky ground that has the name of *Carrs*, which runs almost across Milford Haven, from Peter church towards Llandstadwell, where it renders the landing place difficult to strangers, from its not appearing at low water. The great convenience of this harbour is, that in an hour's time a ship may be in or out of it, and in the way between the Land's End and Ireland. As it lies near the mouth of the Severn, a ship in eight or ten hours may be over on the coast of Ireland, or off the Land's End in the English channel; and a vessel may get out hence to the west much sooner than from either Plymouth or Falmouth. This harbour has been greatly improved by new works, at the expence of the government. The parliament on April 14. 1759 granted 10,000l. for fortifying the harbour of Milford, all of which was expended on the fort at Neyland, which, however, still remains unfinished.

Milford || Military.

MILIARY, in general, something resembling millet seed.

MILIARY Fever. See MEDICINE *Index*.

MILITANT, or CHURCH-MILITANT, denotes the body of Christians while here on earth.

MILITARY, something belonging to the soldiery or militia.

MILITARY Discipline, the training of soldiers, and the due enforcement of the laws and regulations instituted by authority for their conduct.

Next to the forming of troops, military discipline is the first object that presents itself to our notice; it is the soul of all armies; and unless it be established amongst them with great prudence, and supported with unshaken resolution, they are no better than so many contemptible heaps of rabble, which are more dangerous to the very state that maintains them than even its declared enemies.

MILITARY Execution, the ravaging or destroying of a country, or town, that refuses to pay the contribution inflicted upon them.

MILITARY Exercise. See EXERCISE and WORDS *of Command*.

MILITARY State, in British polity, one of the three divisions of the laity. See LAITY.

This state includes the whole of the soldiery, or such persons as are peculiarly appointed among the rest of the people for the safeguard and defence of the realm.

In a land of liberty, it is extremely dangerous to make a distinct order of the profession of arms. In absolute monarchies, this is necessary for the safety of the prince; and arises from the main principle of their constitution, which is that of governing by fear; but, in free states, the profession of a soldier, taken singly and merely as a profession, is justly an object of jealousy. In these no man should take up arms but with a view to defend his country and its laws: he puts not off the citizen when he enters the camp; but it is because he is a citizen, and would wish to continue so, that he makes himself for a while a soldier. The laws therefore, and constitution of these kingdoms, know no such state as that of a perpetual standing soldier, bred up to no other profession than that of war; and it was not till the reign of Henry VII. that the kings of England had so much as a guard about their persons.

In the time of the Anglo-Saxons, as appears from Edward the Confessor's laws, the military force of England was in the hands of the dukes or heretochs, who were constituted through every province and county in the kingdom; being taken out of the principal nobility, and such as were most remarkable for b-

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Military. ing *sapientes, fideles, et animosi.* Their duty was to lead and regulate the English armies with a very unlimited power; *prout eis visum fuerit, ad honorem coronæ et utilitatem regni.* And because of this great power they were elected by the people in their full assembly, or folkmote, in the same manner as sheriffs were elected: following still that old fundamental maxim of the Saxon constitution, that where any officer was entrusted with such power, as, if abused, might tend to the oppression of the people, that power was delegated to him by the vote of the people themselves. So too, among the ancient Germans, the ancestors of our Saxon forefathers, they had their dukes, as well as kings, with an independent power over the military, as the kings had over the civil state. The dukes were elective, the kings hereditary: for so only can be consistently understood that passage of Tacitus, *Reges ex nobilitate, duces ex virtute sumunt.* In constituting their kings, the family or blood royal was regarded; in choosing their dukes or leaders, warlike merit: just as Cæsar relates of their ancestors in his time, that whenever they went to war, by way either of attack or defence, they elected leaders to command them. This large share of power, thus conferred by the people, though intended to preserve the liberty of the subject, was perhaps unreasonably detrimental to the prerogative of the crown: and accordingly we find a very ill use made of it by Edric duke of Mercia, in the reign of King Edmund Ironside; who, by his office of duke or heretoch, was entitled to a large command in the king's army, and by his repeated treacheries at last transferred the crown to Canute the Dane.

It seems universally agreed by all historians, that King Alfred first settled a national militia in this kingdom, and by his prudent discipline made all the subjects of his dominions soldiers: but we are unfortunately left in the dark as to the particulars of this his so celebrated regulation; though, from what was last observed, the dukes seem to have been left in possession of too large and independent a power: which enabled Duke Harold, on the death of Edward the Confessor, though a stranger to the royal blood, to mount for a short space the throne of this kingdom, in prejudice of Edgar Etheling the rightful heir.

Upon the Norman conquest, the feodal law was introduced here in all its rigour, the whole of which is built on a military plan. In consequence thereof, all the lands in the kingdom were divided into what were called *knight's fees*, in number above 60,000; and for every knight's fee, a knight or soldier, *miles*, was bound to attend the king in his wars, for 40 days in a year; in which space of time, before war was reduced to a science, the campaign was generally finished, and a kingdom either conquered or victorious. By this means the king had, without any expence, an army of 60,000 men always ready at his command. And accordingly we find one, among the laws of William the Conqueror, which in the king's name commands and firmly enjoins the personal attendance of all knights and others; *quod habeant et teneant se semper in armis et equis, ut decet et oportet: et quod semper sint prompti et parati ad servitium suum integrum nobis explendum et peragendum, cum opus adfuerit, secundum quod debent de feodis et tenementis suis de jure nobis facere.* This personal service in process of time degenerated into pecuniary commutations or aids; and at last the military part of the feodal system was abolished at the Restoration, by stat. 12 Car. II. c. 24. See *Feodal System.* Military.

In the mean time, we are not to imagine that the kingdom was left wholly without defence in case of domestic insurrections, or the prospect of foreign invasions. Besides those who by their military tenures were bound to perform 40 days service in the field, first the assize of arms, enacted 27 Hen. II. and afterwards the statute of Winchester, under Edward I. obliged every man, according to his estate and degree, to provide a determinate quantity of such arms as were then in use, in order to keep the peace; and constables were appointed in all hundreds by the latter statute, to see that such arms were provided. These weapons were changed, by the statute 4 and 5 Ph. and M. c. 2. into others of more modern service; but both this and the former provisions were repealed in the reign of James I. While these continued in force, it was usual from time to time for our princes to issue commissions of array, and send into every county officers in whom they could confide, to muster and array (or set in military order) the inhabitants of every district; and the form of the commission of array was settled in parliament in the 5 Hen. IV. But at the same time it was provided, that no man should be compelled to go out of the kingdom at any rate, nor out of his shire, but in cases of urgent necessity; nor should provide soldiers unless by consent of parliament. About the reign of King Henry VIII. and his children, lord-lieutenants began to be introduced, as standing representatives of the crown, to keep the counties in military order; for we find them mentioned as known officers in the statute 4 and 5 Ph. and M. c. 3. though they had not been then long in use; for Camden speaks of them in the time of Queen Elizabeth as extraordinary magistrates, constituted only in times of difficulty and danger.

In this state things continued till the repeal of the statutes of armour in the reign of King James I.; after which, when King Charles I. had, during his northern expeditions, issued commissions of lieutenancy, and exerted some military powers which, having been long exercised, were thought to belong to the crown, it became a question in the long parliament, how far the power of the militia did inherently reside in the king; being now unsupported by any statute, and founded only upon immemorial usage. This question, long agitated with great heat and resentment on both sides, became at length the immediate cause of the fatal rupture between the king and his parliament; the two houses not only denying this prerogative of the crown, the legality of which claim perhaps might be somewhat doubtful; but also seizing into their hands the entire power of the militia, the illegality of which step could never be any doubt at all.

Soon after the restoration of King Charles II. when the military tenures were abolished, it was thought proper to ascertain the power of the militia, to recognize the sole right of the crown to govern and command them, and to put the whole into a more regular method of military subordination: and the order in which the militia now stands by law, is principally built upon the statutes which were then enacted. It is true, the two last of them are apparently repealed; but many of their provisions

Military. provisions are re-enacted, with the addition of some new regulations, by the present militia laws; the general scheme of which is to discipline a certain number of the inhabitants of every county, chosen by lot for three years, and officered by the lord-lieutenant, the deputy lieutenants, and other principal landholders, under a commission from the crown. They are not compellable to march out of their counties, unless in case of invasion or actual rebellion, nor in any case compellable to march out of the kingdom. They are to be exercised at stated times: and their discipline in general is liberal and easy; but, when drawn out into actual service, they are subject to the rigours of martial law, as necessary to keep them in order. This is the constitutional security which our laws have provided for the public peace, and for protecting the realm against foreign or domestic violence; and which the statutes declare as essentially necessary to the safety and prosperity of the kingdom.

When the nation was engaged in war, more veteran troops and more regular discipline were esteemed to be necessary, than could be expected from a mere militia; and therefore at such times more rigorous methods were put in use for the raising of armies and the due regulation and discipline of the soldiery, which are to be looked upon only as temporary excrescences bred out of the distemper of the state, and not as any part of the permanent and perpetual laws of the kingdom. For martial law, which is built upon no settled principles, but is entirely arbitrary in its decisions, is, as Sir Matthew Hale observes, in truth and reality no law, but something indulged rather than allowed as a law. The necessity of order and discipline in an army is the only thing which can give it countenance; and therefore it ought not to be permitted in time of peace, when the king's courts are open for all persons to receive justice according to the laws of the land. Wherefore, Thomas earl of Lancaster being convicted at Pontefract, 15 Edward II. by martial law, his attainder was reversed 1 Edward III. because it was done in time of peace. And it is laid down, that if a lieutenant, or other, that hath commission of martial authority, doth in time of peace hang or otherwise execute any man by colour of martial law, this is murder; for it is against *magna charta*. And the petition of right enacts, that no soldier shall be quartered on the subject without his own consent; and that no commission shall issue to proceed within this land according to martial law. And whereas, after the Restoration, King Charles II. kept up about 5000 regular troops, by his own authority, for guards and garrisons, which King James II. by degrees increased to no less than 30,000, all paid from his own civil list; it was made one of the articles of the bill of rights, that the raising or keeping a standing army within the kingdom in time of peace, unless it be with consent of parliament, is against law.

But as the fashion of keeping standing armies (which was first introduced by Charles VII. in France 1445) has of late years universally prevailed over Europe (though some of its potentates, being unable themselves to maintain them, are obliged to have recourse to richer powers, and receive subsidiary pensions for that purpose), it has also for many years past been annually judged necessary by our legislature for the safety of the kingdom, the defence of the possessions of the crown of Great Britain, and the preservation of the balance of power in Europe, to maintain even in time of peace a standing body of troops, under the command of the crown; who are however *ipso facto* disbanded at the expiration of every year, unless continued by parliament. And it was enacted by statute 10 William III. c. 1. that not more than 12,000 regular forces should be kept on foot in Ireland, though paid at the charge of that kingdom: which permission is extended by statute 8 Geo. III. c. 13. to 16,235 men in time of peace. Military.

To prevent the executive power from being able to oppress, says Baron Montesquieu, it is requisite that the armies with which it is intrusted should consist of the people, and have the same spirit with the people: as was the case at Rome, till Marius new-modelled the legions by enlisting the rabble of Italy, and laid the foundation of all the military tyranny that ensued. Nothing then, according to these principles, ought to be more guarded against in a free state, than making the military power, when such a one is necessary to be kept on foot, a body too distinct from the people. Like ours, therefore, it should wholly be composed of natural subjects; it ought only to be enlisted for a short and limited time; the soldiers also should live intermixed with the people; no separate camp, no barracks, no inland fortresses should be allowed. And perhaps it might be still better, if, by dismissing a stated number, and enlisting others at every renewal of their term, a circulation could be kept up between the army and the people, and the citizen and the soldier be more intimately connected together.

To keep this body of troops in order, an annual act of parliament likewise passes, "to punish mutiny and desertion, and for the better payment of the army and their quarters." This regulates the manner in which they are to be dispersed among the several inn-keepers and victuallers throughout the kingdom; and establishes a law martial for their government. By this, among other things, it is enacted, that if any officer or soldier shall excite, or join any mutiny, or, knowing of it, shall not give notice to the commanding officer, or shall desert, or list in any other regiment, or sleep upon his post, or leave it before he is relieved, or hold correspondence with a rebel or enemy, or strike or use violence to his superior officer, or shall disobey his lawful commands; such offender shall suffer such punishment as a court martial shall inflict, though it extend to death itself.

However expedient the most strict regulations may be in time of actual war, yet in times of profound peace, a little relaxation of military rigour would not, one should hope, be productive of much inconvenience. And, upon this principle, though by our standing laws (still remaining in force, though not attended to) desertion in time of war is made felony without benefit of clergy, and the offence is triable by a jury, and before the judges of the common law; yet, by our militia laws before mentioned, a much lighter punishment is inflicted for desertion in time of peace. So, by the Roman law also, desertion in time of war was punished with death, but more mildly in time of tranquillity. But our mutiny act makes no such distinction: for any of the faults above mentioned, are equally at all times, punishable with death itself, if a court martial shall think proper. This discretionary power of

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Military. the court martial is indeed to be guided by the directions of the crown: which, with regard to military offences, has almost an absolute legislative power. "His Majesty (says the act) may form articles of war, and constitute courts martial, with power to try any crime by such articles, and inflict such penalties as the articles direct." A vast and most important trust! an unlimited power to create crimes, and annex to them any punishments not extending to life or limb! These are indeed forbidden to be inflicted, except for crimes declared to be so punishable by this act; which crimes we have just enumerated, and among which, we may observe, that any disobedience to lawful commands is one. Perhaps in some future revision of this act, which is in many repects hastily penned, it may be thought worthy the wisdom of parliament to ascertain the limits of military subjection, and to enact express articles of war for the government of the army, as is done for the government of the navy; especially as, by our present constitution, the nobility and gentry of the kingdom, who serve their country as militia officers, are annually subjected to the same arbitrary rule during their time of exercise.

One of the greatest advantages of our law is, that not only the crimes themselves which it punishes, but also the penalties which it inflicts, are ascertained and notorious: nothing is left to arbitrary discretion: the king by his judges dispenses what the law has previously ordained, but is not himself the legislator. How much, therefore, is it to be regretted, that a set of men, whose bravery has so often preserved the liberties of their country, should be reduced to a state of servitude in the midst of a nation of freemen; for Sir Edward Coke will inform us, that it is one of the genuine marks of servitude, to have the law, which is *Blackst. Comment.* our rule of action, either concealed or precarious; *Miscra est servitus, ubi jus est vagum aut incognitum.* Nor is this state of servitude quite consistent with the maxims of sound policy observed by other free nations. For the greater the general liberty is which any state enjoys, the more cautious has it usually been in introducing slavery in any particular order or profession. These men, as Baron Montesquieu observes, seeing the liberty which others possess, and which they themselves are excluded from, are apt (like eunuchs in the eastern seraglios) to live in a state of perpetual envy and hatred towards the rest of the community, and indulge a malignant pleasure in contributing to destroy those privileges to which they can never be admitted. Hence have many free states, by departing from this rule, been endangered by the revolt of their slaves; while, in absolute and despotic governments, where no real liberty exists, and consequently no invidious comparisons can be formed, such incidents are extremely rare. Two precautions are therefore advised to be observed in all prudent and free governments: 1. To prevent the introduction of slavery at all: or, 2. If it be already introduced, not to intrust those slaves with arms who will then find themselves an overmatch for the freemen. Much less ought the soldiery to be an exception to the people in general, and the only state of servitude in the nation.

But as soldiers, by this annual act, are thus put in a worse condition than any other subjects; so, by the humanity of our standing laws, they are in some cases put in a much better. By statute 43 Eliz. c. 3. a weekly allowance is to be raised in every county for the relief of soldiers that are sick, hurt, and maimed: not forgetting the royal hospital at Chelsea for such as are worn out in their duty. Officers and soldiers, that have been in the king's service, are by several statutes, enacted at the close of several wars, at liberty to use any trade or occupation they are fit for, in any town in the kingdom (except the two universities), notwithstanding any statute, custom, or charter to the contrary. And soldiers in actual military service may make nuncupative wills, and dispose of their goods, wages, and other personal chattels, without these forms, solemnities, and expences, which the law requires in other cases. Our law does not indeed extend this privilege so far as the civil law, which carried it to an extreme that borders upon the ridiculous: for if a soldier, in the article of death, wrote any thing in bloody letters on his shield, or in the dust of the field with his sword, it was a very good military testament. Military || Milk.

Military Court. See CHIVALRY, *Court of.*

Military Tenures. See TENURE, *Feodal System*, and KNIGHT.

Military Ways (*viæ militares*), are the large Roman roads which Agrippa procured to be made through the empire in the time of Augustus, for the more convenient marching of troops and conveyance of carriages. N. Bergier has written the history of the origin, progress, and amazing extent, of these military roads, which were paved from the gates of Rome to the extreme parts of the empire. See WAY.

MILITIA, in general, denotes the body of soldiers, or those who make profession of arms.

In a more restrained sense, militia denotes the trained bands of a town or country, who arm themselves, upon a short warning, for their own defence. So that, in this sense, militia is opposed to regular or stated troops. See *Military State*, and *Feodal System*.

MILIUM, MILLET, a genus of plants, belonging to the triandria class; and in the natural method ranking under the 4th order, *Gramina*. See BOTANY *Index*.

MILK, a well known fluid, prepared by nature in the breasts of women, and the udders of other animals, for the nourishment of their young.—According to Dr Cullen*, milk is a connecting and intermediate substance between animals and vegetables. It seems immediately to be secreted from the chyle, both being a white liquor of the same consistence: it is most copiously secreted after meals, and of an accescent nature. In most animals who live on vegetables, the milk is accescent; and it is uncertain, though at the same time no observation proves the contrary, whether it is not so likewise in carnivorous animals. But, whatever be in this, it is certain, that the milk of all animals who live on vegetables is accescent. Milk being derived from the chyle, we thence conclude its vegetable nature; for in those who live on both promiscuously, more milk is got, and more quickly, from the vegetable than the animal food. Milk, however, is not purely vegetable; though we have a vegetable liquor that resembles its taste, consistence, colour, accescency, and the separability of the oily part, viz. an emulsion of the nuces oleosæ and farinaceous substances. But these want the coagulable part of milk, which seems

* *Lect. on Mat. Med.*

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Milk. to be of animal nature, approaching to that of the coagulable lymph of the blood. Milk, then, seems to be of an intermediate nature, between chyle taken up from the intestines and the fully elaborated animal fluid.

Its contents are of three kinds: 1st, An oily part, which, whatever may be said concerning the origin of other oils in the body, is certainly immediately derived from the oil of the vegetables taken in; as with these it agrees very exactly in its nature, and would entirely, if we could separate it fully from the coagulable part. Another mark of their agreement is the separability, which proves that the mixture has been lately attempted, but not fully performed. 2dly, Besides this oily, there is a proper coagulable part: And, 3dly, Much water accompanies both, in which there is dissolved a saline saccharine substance. These three can be got separate in cheese, butter, and whey; but never perfectly so, a part of each being always blended with every other part.

Nothing is more common, from what has been said of its immediate nature, than to suppose that it requires no assimilation; and hence has been deduced the reason of its exhibition in the most weakly state of the human body. But wherever we can examine milk, we always find that it coagulates, suffers a decomposition, and becomes acescent. Again, Infants, who feed entirely on milk, are always troubled with eructations, which every body observes are not of the same quality with the food taken; and therefore it appears, that, like all other food, milk turns naturally acescent in the stomach, and only enters the chyle and blood in consequence of a new recomposition. It approaches then to the nature of vegetable aliment, but is not capable of its noxious vinous fermentation, and therefore has an advantage over it; neither from this quality, like animal food, is it heating in the stomach, and productive of fever; though at the same time, from its quantity of coagulable matter, it is more nourishing than vegetables.

Milk is the food most universally suited to all ages and states of the body; but it seems chiefly designed by nature as the food of infants. When animals are in the fœtus state, their solids are a perfect jelly, incapable of an assimilatory power. In such state nature has perfectly assimilated food, as the albumen ovi in the oviparous, and in the viviparous animals certainly somewhat of the same kind, as it was necessary the vessels should be filled with such a fluid as would make way for an after assimilation. When the infant has attained a considerable degree of firmness, as when it is separated from the mother, yet such a degree of weakness still remains as makes somewhat of the same indication necessary; it behoves the infant to have an alkalescent food ready prepared, and at the same time its noxious tendency to be avoided. Milk then is given, which is alkalescent, and, at the same time, has a sufficient quantity of acidity to correct that alkalescency. As the body advances in growth, and the alkalescent tendency is greater, the animal, to obviate that tendency, is led to take vegetable food, as more suited to its strength of assimilation.

Dr Cullen observes, that milk is suited to almost all temperaments; and it is even so to stomachs disposed to acescency, more than those substances which have undergone the vinous fermentation; nay, it even cures the heartburn, checks vinous fermentation; and precipitates the lees, when, by renewal of fermentation, the wine happens to be fouled. It therefore very properly accompanies a great deal of vegetable aliment: although sometimes its acescency is troublesome, either from a large proportion taken in, or from the degree of it; for, according to certain unaccountable circumstances, different acids are formed in the stomach in different states of the body; in a healthy body *e. g.* a mild one; in the hypochondriac disease sometimes, one of a very acrid quality. When the acidity of milk is carried to a great degree, it may prove remarkably refrigerant, and occasion cold crudities, and the recurrence of intermittent fevers. To take the common notion of its passing unchanged into the blood, it can suffer no solution. But if we admit its coagulum in the stomach, then it may be reckoned among soluble or insoluble foods, according as that coagulum is more or less tenacious. Formerly rennet, which is employed to coagulate milk, was thought an acid; but, from late observations, it appears, that, if it be an acid, it is very different from other acids, and that its coagulum is stronger than that produced by acids. It has been imagined, that a rennet is to be found in the stomachs of all animals, which causes coagulation of milk; but according to Dr Cullen the coagulation of milk seems to be owing to a weak acid in the stomach, the relics of our vegetable food, inducing, in healthy persons, a weak and soluble coagulum: but in different stomachs this may be very different, in these becoming heavy and less soluble food, and sometimes even evacuated in a coagulated undissolved state both by stomach and stool. Milk.

As milk is acescent, it may be rendered sometimes purgative by mixing with the bile; and some examples of this have been remarked. More commonly, however, it is reckoned among those foods which occasion costiveness.

Hoffman, in his experiments on milk, found that all kinds of it contained much water; and when this was dissipated, found the residuums very different in their solubility. But we must not thence conclude, that the same insolubility takes place in the stomach; for extracts made from vegetables with water are often very insoluble substances, and hardly diffusible through water itself: therefore, in Hoffman's extracts, if we may so call them, of milk, somewhat of the same kind might have appeared; and these substances, which in their natural state were not so, might appear very insoluble. However, we may allow that milk is always somehow insoluble in the intestines, as it is of a drying nature, and as cheese, &c. is very costive. And this effect shows that milk is always coagulated in the stomach; for if it remained fluid, no feces would be produced, whereas sometimes very hard ones are observed. In the blood vessels, from its animal nature, it may be considered as nutritious; but when we consider its vegetable contents, and acescency in the primæ viæ, we find that, like animal food, it does not excite that degree of fever in the time of digestion, and that from its acescency it will resist putrefaction. Hence its use in hectic fevers, which, whatever be their cause,

Milk. appear only to be exacerbations of natural feverish paroxysms, which occur twice every day, commonly after meals, and at night. To obviate these, therefore, we give such an aliment as produces the least exacerbation of these fevers: and of this nature is milk, on account of its acescent vegetable nature.

There appears also somewhat peculiar to milk, which requires only a small exertion of the animal powers in order to its assimilation; and besides, in hectic complaints there is wanted an oily, bland food, approaching to the animal nature; so that on all these accounts milk is a diet peculiarly adapted to them, and, in general, to most convalescents, and to those of inflammatory temperaments. So far of milk in general. We shall now speak of the particular kinds which are in common use.

The milks of women, mares, and asses, agree very much in their qualities, being very dilute, having little solid contents, and, when evaporated to dryness, having these very soluble, containing much saccharine matter, of a very ready acescency, and, when coagulated, their coagulum being tender and easily broke down. From this view they have less oil, and seem to have less coagulable matter than the rest.

The milks of cows, sheep, and goats, agree in opposite qualities to the three just mentioned; but here there is somewhat more of gradation. Cows milk comes nearest to the former milk: goats milk is less fluid, less sweet, less flatulent, has the largest proportion of insoluble part after coagulation, and indeed the largest proportion of coagulable part; its oily and coagulable parts are not spontaneously separable, never throwing out a cream, or allowing butter to be readily extracted from it. Hence the virtues of these milks are obvious, being more nourishing, though at the same time less easily soluble in weak stomachs, than the three first, less acescent than these, and so more rarely laxative, and peculiarly fitted for the diet of convalescents without fever. The three first again are less nourishing, more soluble, more laxative, as more acescent, and adapted to the convalescents with fever.

These qualities, in particular milks, are considerably diversified by different circumstances. First, Different animals, living on the same diet, give a considerably different milk; for there seems to be something in the constitution, abstracting from the aliment, which constitutes a considerable diversity of milk, not only in the same species of animals, but also in the some animal, at different ages, and at different distances after delivery: this applies to the choice of nurses. Secondly, Milk follows the nature of the aliment more than any other juice in the human body, being more or less fluid and dilute, more or less solid and nourishing, in proportion as these qualities are more or less in the aliment. The nature of the aliment differs according to its time of growth, *e. g.* old grass being always found more nourishing than young. Aliment, too, is always varied according to the season, as that is warm or dry, moist or cloudy.

The milk of each particular kind of animal is fitter for particular purposes, when fed on proper food.—Thus the cow delights in the succulent herbage of the vale: if the sheep be fed there he certainly rots, but on the higher and more dry side of the mountain he feeds pleasantly and healthy; while the goat never stops near the bottom, but ascends to the craggy summit: and certainly the milks of these animals are always best on their proper soil, and that of goats is best on a mountainous country. From a dissertation of Linnæus, we have many observations concerning the diversity of plants on which each animal chooses to feed. All the Swedish plants which could be collected together, were presented alternately to domestic animals, and then it appeared that the goat lived on the greatest variety, and even on many which were poisonous to the rest; that the cow chose the first succulent shoots of the plant, and neglected the fructification; which last was preferred by the goat. Hence may he deduced rules concerning the pasturage of different animals; *e. g.* Farmers find, that, in a pasture which was only fit to feed a certain number of sheep, an equal number of goats may be introduced, while the sheep are no less nourished than before. Milk.

It is not easy to assign the difference between milk fresh drawn and that detained in the open air for some time: but certainly there is some material one, otherwise nature universally would not have directed infants to sucking; and indeed it seems better than the other, fitted for digestion and nourishment. Physicians have supposed that this depended on the evaporation of some *spt. rector*: but our author cannot conceive any such, except common water here; and besides, these volatile parts can hardly be nutritious. A more plausible account seems deducible from mixture: milk new drawn has been but lately mixed, and is exposed to spontaneous separation, a circumstance hurtful to digestion; none of the parts being, by themselves, so easily assimilated as when they are all taken together. Hence, then, milk new drawn is more intimately blended, and therefore then is most proper to the weakly and infants.

Another difference in the use of milk exposed for some time to the air, is taking it boiled or unboiled. Physicians have generally recommended the former; but the reason is not easily assigned. Perhaps it is this: Milk kept for some time exposed to the air has gone so far to a spontaneous separation; whereas the heat thoroughly blends the whole, and hence its resolution is not so easy in the stomach; and thus boiled milk is more costive than raw, and gives more fæces. Again, When milk is boiled, a considerable quantity of air is detached, as appears from the froth on the surface; and air is the chief instrument of fermentation in bodies; so that after this process it is not liable to acescency: for these reasons it is proper for the robust and vigorous.

Another difference of milk is, according as it is fluid or coagulated. The coagulated is of two kinds, as induced by rennet, or the natural acescency of the milk. The former preparation makes the firmer and less easily soluble coagulum; though, when taken with the whey unseparated, it is less difficult of solution, though more so than any other coagulum in the same case. Many nations use the latter form, which is easier soluble, but very much acescent, and therefore, in point of solution, should, be confined to the vigorous, in point of acescency, to those who live on alkalescent food; and in the last case, the Laplanders use it as their chief

acescent

Milk. aceseent eondiment. From the same considerations it is more cooling, and in its other effects like all other aceseent vegetables.

Milk by evaporation yields a sweet saline matter, of which Dr Lewis gives the following proportion:

Twelve ounces of	Left of dry matter	From which water extracted a sweet saline substance amounting to
Cows milk	13 drachms.	$1\frac{1}{2}$ drachms.
Goats milk	$12\frac{1}{2}$	$1\frac{1}{2}$
Human milk	8	6
Asses milk	8	6

The saline substanee extracted from asses milk was white, and sweet as sugar; those of the others brown or yellow, and considerably less sweet; that from cows milk had the least sweetness of any.

On distilling 12 quarts of milk *in balneo mariæ*, at least nine quarts of pure phlegm were obtained; the liquor which afterwards arose was acidulous, and by degrees grew sensibly more and more acid as the distillation was continued. After this came over a little spirit, and at last, the empyreumatic oil. The remaining solid matter adhered to the bottom of the retort, in the form of elegant shining black flowers, which being calcined and elixated yielded a portion of fixed alkaline salt.

Milk set in a warm place, throws up to the surface an unctuous cream, from which, by agitation, the butter is easily separated. The addition of alkaline salts prevents this separation, not (as some have supposed) by absorbing an acid from the milk, but by virtue of their property of intimately uniting oily bodies with watery liquors. Sugar, another grand intermedium betwixt oils and water, has this effect in a greater degree, though that concrete is by no means alkaline, or an absorbent of acids.

The sweet saccharine part of the milk remains dissolved in the whey after the separation of the curd or cheesy matter, and may be collected from it in a white crystalline form, by boiling the whey till all remains of the curdled substance have fallen to the bottom; then filtering, evaporating it to a due consistence, setting it to shoot, and purifying the crystals by solution in water and a second crystallization. Much has been said of the medicinal virtues of this sugar of milk, but it does not seem to have any considerable ones: It is from cows milk that it has been generally prepared; and the crystals obtained from this kind of milk have but little sweetness.

When milk is suffered to coagulate spontaneously, the whey proves acid, and on standing grows more and more so till the putrefactive state commences. Sour whey is used as an acid, preferable to the directly vegetable or the mineral acids, in some of the chemical arts; as for dissolving iron in order to the staining of linen and leather. This acid was commonly made use of in the bleaching of linen, for dissolving and extracting the earthy particles left in the cloth by the alkaline salts and lime employed for cleansing and whitening it. Butter milk is preferred to plain sour milk or sour whey: This last is supposed to give the cloth a yellow colour. Dr Home, in his ingenious treatise on this subject, recommends water acidulated with sulphuric acid (in the proportion of about half an ounce, or at most three quarters of an ounce, to a gallon), as preferable in many respects to the acid of milk, or of the more directly vegetable substances. Milk

He observes, that the latter are often difficultly procurable, abound with oleaginous particles, and hasten to corruption; whilst the vitriolic acid is cheap, and pure, and indisposed to putrefy: That milk takes five days to perform its office, whilst the vitriolic acid does it in as many hours, perhaps in as many minutes: That this acid contributes also to whiten the cloth, and does not make it weaker though the cloth be kept in it for months. He finds, that acid, as well as alkalies, extract an oily matter from the cloth, and lose their acidity and alkalicity. Since this treatise appeared, the use of sour milk is very generally superseded by oil of vitriol.

It is observable, that asses milk is greatly disposed, on standing for a little time, to become thick and ropy. In the Breslaw collection for the year 1720, there is a remarkable account of milk (which probably was that of the ass) grown so thick and tenacious as to be drawn out into long strings, which, when dried, were quite brittle.

New cows milk, suffered to stand for some days on the leaves of butterwort or sun-dew, becomes uniformly thick, slippery, and coherent, and of an agreeable sweet taste, without any separation of its parts. Fresh milk, added to this, is thickened in the same manner, and this successively. In some parts of Sweden, as we are informed in the Swedish Memoirs, milk is thus prepared for food.

New milk has a degree of glutinous quality, so as to be used for joining broken stone ware. There is a far greater tenacity in cheese properly prepared.

Milk, when examined by a microscope, appears composed of numerous globules swimming in a transparent fluid. It boils in nearly the same degree of heat with common water; some sorts rather sooner, and some a little later: after boiling, it is less disposed to grow sour than in its natural state. It is coagulated by acids both mineral and vegetable, and by alkalies both fixed and volatile. The coagulum made by acids falls to the bottom of the serum; that made by alkalies swims on the surface, commonly forming (especially with volatile alkalies) a thick coriaceous skin. The serum, with alkalies, proves green or saffron; with acids, it differs little in appearance from the whey that separates spontaneously. The coagulum formed by acids is dissolved by alkalies, and that formed by alkalies is redissolved by acids; but the milk does not in either case resume its original properties. It is coagulated by most of the middle salts, whose basis is an earth or a metallic body; as solution of alum, fixed sal ammoniac, sugar of lead, green and blue vitriol; but not by the chalybeate or purging mineral waters, nor by the bitter salt extracted from the purging waters. Among the neutral salts that have been tried, there is not one that produces any coagulation. They all dilute the milk, and make it less disposed to coagulate with acids or alkalies: Nitre seems to have this effect in a greater degree than the other neutral salts. It is instantly coagulated by [illegible]

Milk. rectified spirit of wine, but scarcely by a phlegmatic spirit. It does not mingle with expressed oils. All the coagula are dissolved by gall.

It has generally been supposed by medical authors, that the milk of animals is of the same nature with chyle, and that the human milk always coagulates in the stomach of infants; but in a late dissertation upon the subject by Mr Clarke, member of the Royal Irish Academy, we find both these positions controverted. According to him, women's milk, in a healthy state, contains no coagulable, mucilaginous, or cheesy principle, in its composition; or it contains so little, that it cannot admit of any sensible proof. Dr Rutty states, that it does not afford even a sixth part of the curd which is yielded by cows milk; and Dr Young denies that it is at all coagulable either by rennets or acids. This *Irish Trans. for* 1788. is confirmed by Dr Ferris, who in 1782 gained the Harveian prize medal at Edinburgh by a dissertation upon milk. Mr Clarke informs us, that he has made a vast number of experiments upon women's milk with a view to determine this point. He made use of ardent spirits, all the different acids, infusions of infants stomachs, and procured the milk of a great many different women; but in no instance, excepting one or two, did he perceive any thing like curd. This took place in consequence of a spontaneous acescency; and only a small quantity of soft flaky matter was formed, which floated in the serum. This he looked upon to be a morbid appearance.

The general opinion that women's milk is coagulable has arisen from a single circumstance, viz. that infants frequently vomit the milk they suck in a state of apparent coagulation. This greatly perplexed Dr Young; who, after having tried in vain to coagulate human milk artificially, concluded, that the process took place spontaneously in the stomach; and that it would always do so if the milk were allowed to remain in a degree of heat equal to about 96 degrees of Fahrenheit. Mr Clarke took equal quantities of three different kinds of milk, and put them into bottles slightly corked, and these bottles into water, the temperature of which was kept up by a spirit of wine lamp as near as possible to 96° of Fahrenheit: but after frequently examining each bottle during the course of the experiment, at the expiration of several hours there was not the smallest tendency towards coagulation to be perceived in any of them; the cream was only thrown to the surface in a thick and adhesive form, and entirely separated from the fluid below, which had something of a gray and wheyish appearance. As the matter vomited by infants is sometimes more adhesive than we can suppose cream to be, Mr Clarke supposed that the curd might be so entangled with the cream, as to be with difficulty separated from it; but having collected a quantity of rich cream from the milk of different women, he repeated the experiment with precisely the same event, not being able in any one instance to produce the smallest quantity of curd. To determine, however, what effects might be produced upon milk by the stomach of an infant, Mr Clarke made the following experiment: Having taken out the stomach of a fœtus which had been deprived of life by the use of instruments, he infused it in a small quantity of hot water, so as to make a strong infusion. He added a tea-spoonful of this infusion to equal quantities of cows and human milk; the consequence of which was, that the cow's milk was firmly coagulated in a short time, but the human milk was not altered in the least; neither was the least coagulation produced by adding a second and third spoonful to the human milk. "Upon the whole, then, (says Mr Clarke), I am persuaded it will be found, that human milk, in an healthy state, contains little or no curd, and that the general opinion of its nature and properties is founded upon fallacious analogy and superficial observations made on the matter vomited by infants. We may presume, that the cream of women's milk, by its inferior specific gravity, will swim on the surface of the contents of the stomach; and being of an oily nature, that it will be of more difficult digestion than any other constituent part of milk. When an infant then sucks very plentifully, so as to over-distend the stomach, or labours under any weakness in the powers of digestion, it cannot appear unreasonable to suppose, that the cream shall be first rejected by vomiting. Analogous to this, we know that adults affected with dyspepsia often bring up greasy fluids from the stomach by eructation, and this especially after eating fat meat. We have, in some instances, known this to blaze when thrown into the fire like spirit of wine or oil." Our author derives a confirmation of his opinion from the following observation, viz. that curds vomited by infants of a few days old are yellow, while they become white in a fortnight or three weeks. This he accounts for from the yellow colour of the cream thrown up by the milk of women during the first four or five days after delivery. Milk

Mr Clarke likewise controverts that common opinion of the human milk being so prone to acidity, that a great number of the diseases of children are to be accounted for from that principle. "Whoever (says he) takes the trouble of attentively comparing human milk with that of ruminant animals, will soon find it to be much less prone to run into the acescent or acid process. I have very often exposed equal quantities of human and cows milk in degrees of temperature, varying from the common summer heat, or 65°, to 100°; and I have constantly found that cows milk acquires a greater degree of acidity in 36 hours than the human did in many days: cows milk becomes offensively putrid in four or five days; a change which healthy human milk, exposed in the same manner, will not undergo in many weeks, nay, sometimes in many months. I once kept a few ounces of a nurse's milk, delivered about six or seven days, for more than two years in a bottle moderately corked. It stood on the chimney-piece, and was frequently opened to be examined. At the end of this period it showed evident marks of moderate acidity, whether examined by the taste, smell, or paper stained with vegetable blues or purples; the latter it changed to a florid red colour, whereas cows milk kept a few days changed the colour of the same paper to a green, thereby clearly showing its putrescent tendency."

Our author next goes on to consider of the probability there is of milk becoming so frequently and strongly acid as to occasion most of the diseases of infants. He begins with an attempt to show that the phenomena commonly looked upon to be indications of acrimony are by no means certain. Curdled milk

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Milk. has already been shown to be no sign of acidity; and the other appearance, which has commonly been thought to be so certain, viz. green fæces, is, in the opinion of Mr Clarke, equally fallacious. In support of this he quotes a letter from Dr Sydenham to Dr Cole; in which he says, that the green matter vomited by hysterical women is not any proof of acrid humours being the cause of that disease, for sea-sick people do the same. The opinion of green fæces being an effect of acidity, proceeds upon the supposition that a mixture of bile with an acid produces a green colour: but it is found, that the vegetable acid, which only can exist in the human body, is unable to produce this change of colour, though it can be effected by the strong mineral acids. As nothing equivalent to any of these acids can be supposed to exist in the bowels of infants, we must therefore take some other method of accounting for the green fæces frequently evacuated by them. "Why should sour milk, granting its existence, give rise to them in infants and not in adults? Have butter milk, summer fruits of the most acescent kind, lemon or orange juice, always this effect in adults by their admixture with bile? This is a question which, I believe, cannot be answered in the affirmative."

On the whole, Dr Clarke considers the disease of acidity in the bowels, though so frequently mentioned, to be by no means common. He owns indeed, that it may sometimes occur in infancy as well as in adults, from weakness of the stomach, costiveness, or improper food; and an indubitable evidence is afforded by fæces which stain the blue or purple colour of vegetables to a red, though nothing can be inferred with certainty from the colour or smell.

The doctor next proceeds to state several reasons for his opinion, that the greater number of infantile diseases are not owing to acidity: 1. Women's milk in a healthy state contains little or no coagulable matter or curd. 2. It shows less tendency out of the body to become acescent than many other kinds of milk. 3. The appearances which have been generally supposed to characterize its acidity do not afford satisfactory evidence of such a morbid cause. 4. Granting this to be the case, we have plenty of mild absorbents, capable of destroying all the acid which can be supposed to be generated in the bowels of an infant; yet many children are observed to die in consequence of these diseases supposed to arise from acidity. 5. Though the milk of all ruminant animals is of a much more acescent nature than that of the human species, yet the young of these animals never suffer any thing like the diseases attributed to acidity in infants. 6. History informs us that whole nations use sour curdled milk as a considerable part of their food, without feeling any inconvenience; which, however, must have been the case, if acidity in the stomach were productive of such deleterious effect as has been supposed.

The reasoning of Dr Clarke seems here to be very plausible, and nothing has as yet been offered to contradict it. The reviewers in taking notice of the treatise only observe, that the doctor's positions are supported by great probability; yet "they have seen them, or think they have seen them, contradicted by the appearance of diseases and the effects of medicines;" so that they must leave the subject to farther examination. Milk.

In a memoir by Messrs Parmentier and Deyeux, members of the royal college of pharmacy, &c. in Paris, we have a great number of experiments on the milk of asses, cows, goats, sheep, and mares, as well as women. The experiments on cows milk, were made with a view to determine whether any change was made in the milk by the different kinds of food eaten by the animal. For this purpose some were fed with the leaves of *maize* or Turkey wheat; some with cabbage; others with small potatoes; and others with common grass. The milk of those fed with the *maize* or Turkey wheat was extremely sweet; that from the potatoes and common grass much more serous and insipid; and that from the cabbages the most disagreeable of all. By distillation only eight ounces of a colourless fluid were obtained from as many pounds of each of these milks; which from those who fed upon grass had an aromatic flavour; a disagreeable one from cabbage; and none at all from the potatoes and Turkey wheat. This liquid became fetid in the space of a month, whatever substance the animal had been fed with, acquiring at the same time a viscidity and becoming turbid; that from cabbage generally, but not always, becoming first putrid. All of them separated a filamentous matter, and became clear on being exposed to the heat of 25° of Reaumur's thermometer. In the residuums of the distillation no difference whatever could be perceived. As the only difference therefore existing in cows milk lies in the volatile part, our authors conclude, that it is improper to boil milk either for common or medicinal purposes. They observed also that any sudden change of food, even from a worse to a better kind was attended by a very remarkable diminution in the quantity of milk. All the residuums of the distillations yielded, in a strong fire, a yellow oil and acid, a thick and black empyreumatic oil, a volatile alkali, and towards the end a quantity of inflammable air, and at last a coal remained containing some fixed alkali with muriatic acid.

On agitating in long bottles the creams from the milk of cows fed with different substances, all of them were formed into a kind of half-made butter; of which that formed from the milk from maize was white, firm, and insipid; that from potatoes was softer and more pinguedinous; but that from common grass was the best of all. Cabbage, as in other cases, gave a strong taste.

In the course of their experiments, it was endeavoured to determine whether butter is actually contained in the cream, or whether it be a chemical production of the operation of churning. They could not find any reason absolutely satisfactory on either side, but incline to the latter opinion; because when cream is allowed to remain among the milk, and the whole curdled promiscuously, only fat cheese, without any butter, is produced. The oily parts cannot be separated into butter either by acids or any other means than churning: even the artificial mixture of oil with the cream is insufficient for the purpose.

The serum of milk was reduced by filtration to a clear and pellucid liquor; and, by mixture with fixed alkali, deposited a portion of cheesy matter which had been

Milk. been dissolved in the whey. The sugar of milk was also found in this liquor.

In their experiments upon the milk of various animals, it was found that the milk of asses yielded by distillation an insipid liquor, and deposited a liquor similar to the lymph of cows milk. It is coagulated by all the acids, but not into an uniform mass; exhibiting only the appearance of distinct floceuli. It affords but little cream, which is converted with difficulty into a soft butter that soon becomes rancid. It has but a small quantity of saccharine particles, and these are often mixed with muriatic selenite and common salt. Goats milk has a thick cream, and agreeable to the taste; and the milk itself may be preserved longer in a sound state than any other species, the seum on its surface being naturally convertible into palatable cheese. It is easily made into firm butter, which does not soon become rancid, and has a good flavour. The butter milk contains a large quantity of cheesy matter, which readily coagulates; but has still less saccharine matter than that of asses. Sheeps milk can scarce be distinguished from that of a cow, and easily parts with its cream by standing. It is of a yellow colour, an agreeable flavour, and yields a great proportion of butter; but this is not solid, and soon becomes rancid. Mares milk is the most insipid and least nutritious of any; notwithstanding which it has been much recommended for weak and consumptive patients: in which cases it is probable that it proves efficacious by being more consonant than any other to the debilitated powers of digestion. It boils with a smaller fire than any other kind of milk, is easily coagulated, and the distilled water does not soon change its nature. It has but a small quantity of cheesy matter, and very few oily particles: the cream cannot be made into butter; and the whey contains about as much sugar as cows or goats milk.

In this memoir our authors remark, that in order to augment the quantity, as well as to improve the quality, of the milk of animals, they should be well fed, their stalls kept clean, and their litter frequently renewed: they should be milked at stated hours, but not drained: great attention should also be paid to the breed; because inferior cattle are maintained at as great expence as the most valuable kinds. No change ought to be made in the food; though if the milk be employed for medicinal purposes, it may be improved by a proper mixture of herbs, &c.

In their experiments on women's milk, Messrs Parmentier and Deyeux differ somewhat from Dr Clarke. They first tried the milk of a woman who had been delivered four months: and observed, that after the cream had been separated the other part appeared of a more perfect white, and that it could not be coagulated either by vinegar or mineral acids; which they attributed to a superabundance of serum. But they found that in proportion to the age of the milk it was found to be more easily coagulable; and this was confirmed by experiments made upon the milk of 20 nurses. Its coagulability was not increased by heat. The cream, by agitation, formed a viscid unctuous matter, but could not be changed into perfect butter; but they found that it was extremely difficult to determine the proportions of the various component parts in human milk, as it differs remarkably, not only in different subjects, but in the same subject at different times. In a nurse aged about 32 years, who was extremely subject to nervous affections, the milk was one day found almost quite colourless and transparent. In two hours after, a second quantity drawn from the breast was viscid like the white of an egg. It became whiter in a short time, but did not recover its natural colour before the evening. It was afterwards found that these changes were occasioned by her having some violent hysteric fits in the mean time. Milk.

Sugar of Milk. Different methods have been proposed for obtaining the sugar of milk. The following is an account of a method used by some of the Tartar nations of preserving their milk by means of frost: in which operation great quantities of the sugar of milk are accidentally formed. The account was given by Mr Fabrig of Petersburgh, who undertook a journey, by order of the academy of Petersburgh, among the Mogul tribes who inhabit the country beyond the lake Baikal, on the banks of the river Selenga. These people allow their milk to freeze in large quantity in iron kettles; and, when it is perfectly congealed, they place them over a gentle fire to soften the edges of the cake, after which it may be taken out with a wooden spatula. They commence these operations at the beginning of the cold, when they have milk in the greatest abundance; after which it may be preserved with great ease throughout the whole winter. Mr Fabrig having frequent opportunities of seeing these cakes, soon observed, that the surface of them was covered to a considerable depth with a farinaceous powder; and having established a dairy upon the same plan with those of the Moguls, he found the same thing take place with himself. This powder was extremely sweet, and he received platefuls of it from the natives, who used it in their food, and sweetened their other victuals with it. Having caused a number of cakes of frozen milk to be conveyed to the top of his house, where they were directly exposed to the violent cold, he found that the separation of the saccharine powder was greatly promoted by this means. He scraped the cakes every week to the depth of two inches, and afterwards spread out the powder upon an earthen plate in order to destroy the remains of moisture which might have prevented it from keeping for any length of time. When exposed in this manner it had a very agreeable and strong saccharine taste; dissolved in warm water; and when strongly stirred by means of a chocolate stick, would at all times produce an excellent and well tasted milk. Raw milk affords a much larger quantity of this saccharine matter than such as has been boiled, or which has had the cream taken off it. Neither must the milk be suddenly exposed to the cold before it has lost its natural heat; for the sudden contact of the cold drives all the cheesy and fat part towards the middle, while the external parts consist of little else than water. In order to allow the parts of the milk to be all properly mixed together, Mr Fabrig allowed the milk when newly taken from the cows to cool, and then poured it out into shallow kettles.

Our author is of opinion that this method of making milk would be of great service to navigators to supply themselves with milk during long sea voyages: and he

Milk. he assures us, from his own experience, that it will always succeed, if proper attention be paid to it. He is of opinion, however, that all countries are not equally proper for the preparation of this saccharine matter: and indeed this seems very evidently to be the case, as the process appears to be a crystallization of the saccharine parts of the milk, and a separation of them from the aqueous ones by means of extreme cold. The country in which he made the experiments is one of the most elevated in all Asia; and so cold, that, though it lies only in the 50th degree of north latitude, its rivers are frozen up for six months of the year. A very dry cold wind also prevails throughout almost the whole year; and the dry winds generally come from the north, being almost always preceded by a warm wind from the south, which blows for some time. The dry rarefied air increases the evaporation from the ice cakes, and leaves nothing but the saccharine or pure constituent parts of the milk, which with the addition of water can always recompose the fluid.

Milk, in the wine trade. The coopers know very well the use of skimmed milk, which makes an innocent and efficacious forcing for the fining down of all white wines, arracks, and small spirits; but it is by no means to be used for red wines, because it discharges their colour. Thus, if a few quarts of well skimmed milk be put into a hogshead of red wine, it will soon precipitate the greater part of the colour, and leave the whole nearly white: and this is of known use in the turning of red wines, when pricked, into white; in which a small degree of acidity is not so much perceived.

Milk is, from this quality of discharging colour from wines, of use also to the wine coopers, for the whitening of wines that have acquired a brown colour from the cask, or from having been hastily boiled before fermenting; for the addition of a little skimmed milk, in these cases, precipitates the brown colour, and leaves the wines almost limpid, or of what they call a *water whiteness*, which is much coveted abroad in wines as well as in brandies.

Milk of Lime; Milk of Sulphur. The name of *milk* is given to substances very different from *milk* properly so called, and which resemble milk only in colour. Such is water in which quicklime has been slaked, which acquires a whiteness from the small particles of the lime being suspended in it, and has hence been called the milk of *lime*. Such also is the solution of liver of *sulphur*, when an acid is mixed with it, by which white particles of sulphur are made to float in the liquor.

Milk of Vegetables. For the same reason that milk of animals may be considered as a true animal emulsion, the emulsive liquors of vegetables may be called *vegetable milks*. Accordingly emulsions made with almonds are commonly called *milk of almonds*. But besides this vegetable milk, which is in some measure artificial, many plants and trees contain naturally a large quantity of emulsive or milky juices. Such are lettuce, spurge, fig tree, and the tree which furnishes the elastic American resin. The milky juices obtained from all these vegetables derive their whiteness from an oily matter, mixed and undissolved in a watery or mucilaginous liquor. Most resinous gums were originally such milky juices, which afterwards become solid by the evaporation of their more fluid and volatile parts. Milk, Mill.

Milk-Fever. See MEDICINE *Index*.

Milky-Hedge, the English name of a shrub growing on the coast of Coromandel, where it is used for hedging. The whole shrub grows very bushy, with numerous erect branches, which are composed of cylindrical joints as thick as a tobacco pipe, of a green colour, and from three to six inches long: the joints are thicker than the other parts, but always give way first on any accidental violence offered to the plant. When broken it yields a milk of an excessively caustic quality, which blisters any part of the skin it touches. When the joints are broken off at each end, the tube then contains but very little milk. In this state Mr Ives ventured to touch it with his tongue, and found it a little sweet. In the hedges it is seldom very woody; but when it is, the wood is very solid, and the bark gray and cracked. This plant, he informs us, has acquired great reputation in curing the venereal disease, on the following account: A poor Portuguese woman, the eldest female of her family, had wrought surprising cures in the most inveterate venereal disorders, even such as the European physicians had pronounced incurable. These facts became so notorious, that the servants of the Company, and especially their surgeons, were induced to offer her a very considerable premium for a discovery of the medicine; but she always refused to comply, giving for a reason, that while it remained a secret, it was a certain provision for the maintenance of the family in the present as well as in future generations. On account of this denial the English surgeons were sometimes at the pains to have her motions without doors carefully watched; and as they were not able to discover that she ever gathered of any other plant or tree but this, they conjectured that the milk of this tree was the specific employed. Mr Ives inquired at the black doctors concerning the virtues of this plant; who all agreed, that it will cure the lues venerea, but differed as to the manner of administering it; some saying that a joint of it should be eaten every morning; others that the milk only should be dropped upon sugar; and then put into milk, oil, &c. and given daily to the patient.

Milky-Way. See ASTRONOMY *Index*.

MILL, a machine for grinding corn, &c. of which there are various kinds, according to the different methods of applying the moving power; as water-mills, wind-mills, mills worked by horses, &c. See MECHANICS *Index*.

The first obvious method of reducing corn into flour for bread would be by the simple expedient of pounding. And that was for ages the only one which was practised by the various descendants of Adam, and actually continued in use among the Romans below the reign of Vespasian. But the process was very early improved by the application of a grinding power, and the introduction of millstones. This, like most of the common refinements in domestic life, was probably the invention of the antediluvian world, and certainly practised in some of the earliest ages after it; and, like most of them, it was equally known in the east and west. Hence the Gauls and Britons appear familiarly acquainted with the use of hand mills before the time of their submission to the Romans: the Britons particularly

Mill. larly distinguishing them, as the Highlanders and we distinguish them at present, by the simple appellations of *querns*, *carnes*, or *stones*. And to these the Romans added the very useful invention of water mills. For this discovery the world is pretty certainly indebted to the genius of Italy; and the machine was not uncommon in the country at the conquest of Lancashire. This, therefore, the Romans would necessarily introduce with their many other refinements among us. And that they actually did, the British appellation of a *water-mill* fully suggests of itself; the *melin* of the Welsh and Cornish, the *mull*, *meill*, and *melin* of the Armoricans, and the Irish *muilean* and *muilind*, being all evidently derived from the Roman *mola* and *molendinum*. The subject Britons universally adopted the Roman name, but applied it, as we their successors do, only to the Roman *mill*; and one of these was probably erected at every stationary city in the kingdom. One plainly was at Manchester, serving equally the purposes of the town and the accommodation of the garrison.—And one alone would be sufficient, as the use of handmills remained very common in both, many having been found about the site of the station particularly; and the general practice having descended among us nearly to the present period. Such it would be peculiarly necessary to have in the camp, that the garrison might be provided against a siege. And the water-mill at Manchester was fixed immediately below the Castlefield and the town, and on the channel of the Medlock. There, a little above the ancient ford, the sluice of it was accidentally discovered about 30 years ago. On the margin of Dyer's croft, and opposite to some new constructions, the current of the river, accidentally swelled with the rains, and obstructed by a dam, broke down the northern bank, swept away a large oak upon the edge of it, and disclosed a long tunnel in the rock below. This has been since laid open in part with a spade. It appeared entirely uncovered at the top, was about a yard in width, and another in depth, but gradually narrowed to the bottom. The sides showed everywhere the marks of the tool on the rock, and the course of it was parallel with the channel. It was bared by the flood about 25 yards only in length, but was evidently continued for several further; having originally begun, as the nature of the ground evinces, just above the large curve in the channel of the Medlock.

Whitaker's Hist. of Manchester.

For the first five or six centuries of the Roman state, there were no public bread bakers in the city of Rome. They were first introduced into it from the east, at the conclusion of the war with Perseus, and about the year 167 before Christ. And, towards the close of the first century, the Roman families were supplied by them every morning with fresh loaves for breakfast.—But the same custom, which prevailed originally among the Romans and many other nations, has continued nearly to the present time among the Mancunians. The providing of bread for every family was left entirely to the attention of the women in it; and it was baked upon stones, which the Welsh denominate *greidiols* and we *gredles*. It appears, however, from the kiln burnt pottery which has been discovered in the British sepulchres, and from the British appellation of an *odyn* or *oven* remaining among us at present, that furnaces for baking were generally known among the original Britons. An odyn would, therefore, be erected at the mansion of each British baron, for the use of himself and his retainers. And, when he and they removed into the vicinity of a Roman station, the oven would be rebuilt with the mansion, and the public bakehouses of our towns commence at the first foundation of them. One bakehouse would be constructed, as we have previously shown one mill to have been set up, for the public service of all the Mancunian families. One oven and one mill appear to have been equally established in the town. And the inhabitants of it appear immemorially accustomed to bake at the one and grind at the other. Both, therefore, were in all probability constructed at the first introduction of water-mills and ovens into the country. The great similarity of the appointments refers the consideration directly to one and the same origin for them. And the general nature of all such institutions points immediately to the first and actual introduction of both. And, as the same establishments prevailed equally in other parts of the north, and pretty certainly obtained over all the extent of Roman Britain, the same erections were as certainly made at every stationary town in the kingdom.

Mill, Millstone.

MILL, *John*, a very learned divine, was born at Shap in Westmoreland, about the year 1645; and became a servitor of Queen's college, Oxford. On his entering into orders he became an eminent preacher, and was made prebendary of Exeter. In 1681, he was created doctor of divinity; about the same time he was made chaplain in ordinary to King Charles II. and in 1685 he was elected principal of St Edmund's hall in Oxford. His edition of the Greek Testament, which will ever render his name memorable, was published about a fortnight before his death, which happened in June 1707. Dr Mills was employed 30 years in preparing this edition.

MILLSTONE, the stone by which corn is ground.—The millstones which we find preserved from ancient times are all small, and very different from those in use at present. Thoresby mentions two or three such found in England, among other Roman antiquities, which were but 20 inches broad; and there is great reason to believe that the Romans, as well as the Egyptians of old, and the ancient Jews, did not employ horses, or wind, or water, as we do, to turn their mills, but made their slaves and captives of war do this laborious work: they were in this service placed behind these millstones, and pushed them on with all their force. Sampson, when a prisoner to the Philistines, was treated no better, but was condemned to the millstone in his prison. The runner or loose millstone, in this sort of grinding, was usually very heavy for its size, being as thick as broad. This is the millstone which is expressly prohibited in Scripture to take in pledge, as lying loose it was more easily removed. The Talmudists have a story, that the Chaldeans made the young men of the captivity carry millstones with them to Babylon, where there seems to have been a scarcity at that time; and hence, probably, their paraphrase renders the text "have borne the mills or millstones;" which might thus be true in a literal sense. They have also a proverbial expression of a man with a millstone about his neck; which they use to express a man under the severest

weight

Millstone || Millennium.

weight of affliction. This also plainly refers to this small sort of stones.

Rhenish MILLSTONE, a stone which has been classed among volcanic products, on account of its appearance, which is a blackish gray, porous, and very much resembling a lava of Mount Vesuvius.

MILLEDGEVILLE, a town in the state of Georgia in North America, situated on the river Occonee, about 150 miles from the sea. Its population in 1810 was 1257. W. Long. 83. 10. N. Lat. 32. 40.

MILLENARIANS, or CHILIASTS, a name given to those in the primitive ages, who believed that the saints will reign on earth with Christ 1000 years. See MILLENIUM.

MILLENER, or MILLINER, one who sells ribbands and dresses, particularly head dresses for women; and who makes up those dresses. Of this word different etymologies have been given. It is not derived from the French. The French cannot express the notion of *milliner*, otherwise than by the circumlocution *marchand* or *marchande des modes*. Neither is it derived from the Low Dutch language, the great, but neglected, magazine, of the Anglo-Saxon. For Sewel, in his Dictionary English and Dutch, 1708, describes *millener* to be "a pedlar who sells ribbands and other trimmings or ornaments; a French pedlar."

Littleton, in his English and Latin Dictionary, published 1677, defines millener, "a jack of all trades;" q. d. *millenarius*, or *mille mercium venditor*; that is, "one who sells a thousand different sorts of things." From this etymology, which seems fanciful, we must hold, that it then implied what is now termed "a haberdasher of small wares."

Before Littleton's time, however, a somewhat nicer characteristic than seems compatible with his notion, appears to have belonged to them; for Shakespeare, in his Henry IV. makes Hotspur, when complaining of the daintiness of a courtier, say,

"He was *perfumed* like a milliner.

The fact seems to be, that there were milleners of several kinds: as, *horse-milleners*, (for so those persons were called who make ornaments of coloured worsted for horses); haberdashers of small wares, the *milleners* of Littleton; and *milleners* such as those now peculiarly known by that name, whether male or female, and to whom Shakespeare's allusion seems most appropriate.

Lastly, Dr Johnson, in his dictionary, derives the word from *milaner*, an inhabitant of *Milan*, from whence people of this profession first came, as a *Lombard* is a banker.

MILLE PASSUS, or *Millia Passuum*; a very common expression among the ancient Romans for a measure of distance, commonly called a *mile*. *Milliarium*, rarely used. Which Hesychius made to consist of seven stadia; Plutarch, little short of eight; but many others, as Strabo and Polybius, make it just eight stadia. The reason of this difference seems to be, that the former had a regard to the Grecian foot, which is greater than the Roman or Italic. This distance is oftentimes called *lapis*, which see. Each passus consisted of five feet (Columella).

MILLENNIUM, "a thousand years;" generally employed to denote the thousand years, during which, according to an ancient tradition in the church, grounded on some doubtful texts in the Apocalypse and other Scriptures, our blessed Saviour shall reign with the faithful upon earth after the first resurrection, before the final completion of beatitude. Millennium.

Though there has been no age of the church in which the millennium was not admitted by individual divines of the first eminence, it is yet evident from the writings of Eusebius, Irenæus, Origen, and others among the ancients, as well as from the histories of Dupin, Mosheim, and all the moderns, that it was never adopted by the whole church, or made an article of the established creed in any nation.

About the middle of the fourth century the Millennians held the following tenets:

1st, That the city of Jerusalem should be rebuilt, and that the land of Judea should be the habitation of those who were to reign on earth 1000 years.

2dly, That the first resurrection was not to be confined to the martyrs; but that after the fall of Antichrist all the just were to rise, and all that were on the earth were to continue for that space of time.

3dly, That Christ shall then come down from heaven, and be seen on earth, and reign there with his servants.

4thly, That the saints during this period shall enjoy all the delights of a terrestrial paradise.

These opinions were founded upon several passages of Scripture, which the Millenarians among the fathers understood in no other than a literal sense, but which the moderns, who hold that opinion, consider as partly literal and partly metaphorical. Of these passages, that upon which the greatest stress has been laid, we believe to be the following:—"And I saw an angel come down from heaven, having the key of the bottomless pit, and a great chain in his hand. And he laid hold on the dragon, that old serpent, which is the devil and Satan, and bound him a *thousand years*, and cast him into the bottomless pit, and shut him up, and set a seal upon him, that he should deceive the nations no more till *the thousand years* should be fulfilled; and after that he must be loosed a little season. And I saw thrones, and they sat upon them, and judgment was given unto them: and I saw the souls of them that were beheaded for the witness of Jesus, and for the word of God, and which had not worshipped the beast, neither his image, neither had received his mark upon their foreheads, or in their hands; and they lived and reigned with Christ a *thousand years*. But the rest of the dead lived not again till *the thousand years were finished*. This is the first resurrection*." This passage all the ancient Millenarians took in a sense grossly literal; and taught, that during the millennium the saints on earth were to enjoy every bodily delight. The moderns, on the other hand, consider the power and pleasure of this kingdom as wholly spiritual; and they represent them as not to commence till after the conflagration of the present earth. But that this last supposition is a mistake, the very next verse except one assures us: for we are there told, that "when the thousand years are expired, Satan shall be loosed out of his prison, and shall go out to deceive the nations which are in the four quarters of *the earth*;" and we have no reason to beli-

* Rev. xx. 1—.

Millennium.

believe that he will have such power or such liberty in "the new heavens and the *new earth* wherein dwelleth righteousness."

For this and other reasons, which our limits will not permit us to enumerate, the most judicious critics contend, that the prophesies of the millennium point, not to a resurrection of martyrs and other just men to reign with Christ a thousand years in a visible kingdom upon earth, but to that state of the Christian church, which, for a thousand years before the general judgment, will be so pure and so widely extended, that, when compared with the state of the world in the ages preceding, it may, in the language of Scripture, be called a resurrection from the dead. In support of this interpretation they quote two passages from St Paul, in which a conversion from Paganism to Christianity, and a reformation of life, is called a resurrection from the dead:—"Neither yield ye your members as instruments of unrighteousness into sin; but yield yourselves unto God as those that are *alive from the dead**:" And again, "Wherefore he saith, Awake thou that sleepest, and *arise from the dead*, and Christ shall give thee light †." It is likewise to be observed, that in all the descriptions of the resurrection and future judgment which are given us at such length in the gospels and epistles, there is no mention made of a *first* and *second* resurrection at the distance of a thousand years from each other. There is indeed an order in the resurrection: for we are told ‡, that "every man shall rise in his own order; Christ the first fruits, afterwards they that are Christ's at his coming," &c. But were the millenarian hypothesis well founded, the words should rather have run thus: "Christ the first fruits, then the martyrs at his coming, and a thousand years afterwards the residue of mankind. Then cometh the end," &c.

* Rom. vi. 13.

† Eph. v. 14.

‡ 1 Cor. xv. 23.

These arguments strongly incline us to believe, that by the reign of Christ and the saints for a thousand years upon earth, nothing more is meant, than that before the general judgment the Jews should be converted, genuine Christianity be diffused through all nations, and mankind enjoy that peace and happiness which the faith and precepts of the gospel are calculated to confer on all by whom they are sincerely embraced.

Our Saviour's own account of his religion is, that from a small beginning it will increase to the full harvest. The millennium therefore is to be considered as the full effect of the Christian principles in the hearts of men, and over the whole world; and the divines who have treated of this subject endeavour to prove, that this is to be expected from the facts which have already existed, and from the importance of the Christian doctrine.

1. The gradual progress of Christianity is no objection to this fact. This is similar to the progress and advancement from less to greater perfection in every thing which possesses vegetable or animal life. The same thing is observed in the arts, in civilization, in societies, and in individuals—and why should it not be admitted to have place in religion? There is, indeed, a general principle on which a gradual progression, both in the natural and moral world, is founded. The Almighty never employs supernatural means where the thing can be accomplished by those which are natural. This idea is of the most general extent through the whole of the present system of nature. The possibility of another plan could easily be admitted; but in this case there would be a total alteration of every part of the works of God or of man that we are acquainted with. In the same manner, if the religion of Christ had been irresistible, it would have totally altered its natural consequences. It was necessary, therefore, from the present condition of man, as an active, intelligent, and accountable being, that means should be employed; and wherever means are employed, the effects produced must be gradual, and not instantaneous.

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2. Though the progress of a divine revelation be gradual, yet it is to be expected, from the wisdom and compassion of God, that it will still be advancing in the hearts of men, and over the world. In the first stage of the church, the word of God, supported by miracles, and by the animated zeal of men who spake what they saw and heard, grew and prevailed. In this case supernatural means were necessary, because the prejudices of the world could not be subdued without them. It was the first watering of a plant which you afterwards leave to the dew of heaven. Miracles at the same time were employed only as the means of conviction; and they were not continued, because in this case they would have become a constant and irresistible principle, incompatible with the condition of man as a reasonable agent. After this power was withdrawn, there were many ages of ignorance and superstition in the Christian church. But what is necessary to be established on this subject is, not that the progress of Christianity has never been interrupted, but that on the whole it has been advancing. The effects of this religion on mankind, in proportion as it was received, were immediate and visible: It destroyed the gross superstition of idol worship; it abolished the practice, which was general in the heathen world, of reducing to the lowest state of servitude the greatest part of our brethren; it softened the horrors of war, even when the vices of mankind made defence necessary; it entered into social and private life, and taught men benevolence, humanity, and mercy. It is in these blessed effects that we can observe the progress of Christianity even to this day. Superstition and idolatry were soon engrafted on the stem which our Saviour planted in the world; but the simplicity of the gospel has been gradually undermining the fabric of superstition; and the men who are most nearly interested in the deceit are now almost ashamed to show their faces in the cause. The practice of slavery has, generally speaking, been extinguished in the Christian world; yet the remains of it have been a disgrace to the Christian name, and the professors of that religion have now begun to see the inconsistency. War is not only carried on with less animosity, and less havock of the human species; but men begin to cultivate more generally, and to delight in, the arts of peace. The increasing spirit of charity and benevolence, of which it were easy to give unexampled instances in the present age, is a decided proof of the increasing influence of Christianity. At the same time, if, instead of these general principles, we were to descend to private examples of infidelity or of wickedness, it would be easy to bring proofs in support of an opposite opinion: but the reasoning would by no means be equally conclusive; for if the general principles by which society is regulated be more liberal and merciful,

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Millennium.

it is evident that there is more goodness in a greater number of the human race. Society is nothing more than a collection of individuals; and the general tone, especially when it is on the side of virtue, which almost in every instance opposes the designs of leading and interested men, is a certain evidence of the private spirit. To show that this reformation is connected with Christianity, it is unnecessary to state any comparison between the influence of heathen, and the influence of Christian principles: between civilization as depending on the powers of the human understanding, and on the efficacy of the word of God. The whole of this controversy may be appealed to an obvious fact, viz. that as any nation has come nearer to the simplicity of the gospel in the standard of its worship, it has been more possessed of those national virtues which we have ascribed to the influence of Christianity. This fact is worth a thousand volumes of speculation on this subject.

3. A revelation sanctioned by God, for a benevolent purpose, will be expected to produce effects corresponding to the wisdom which gave it, and to the purpose for which it is employed. It may be gradual; but it will be increasing, and it must increase, to the full harvest. He that has begun the good work will also finish it. It is reasonable to expect this illustrious success of the gospel, both from the nature of the thing, and from the prophecies contained in the sacred scriptures. The precepts of the gospel, in their genuine sense, are admirably calculated for the peace and welfare both of individuals and society. The greatest liberality of mind, the greatest generosity of temper, the most unbounded love, and the greatest indifference to the accumulation of this world's property, if they flowed from breast to breast, and operated with equal force on all men, would be productive of equal good and happiness to all. We are scarcely able to perceive the force of this at first view, because the deceit and imposition which yet exist in the world, prevent the operation of the best principles even in the best hearts. But in proportion to the improvement of mankind, what is their real interest, and what are the real objects of happiness, will gradually unfold. The contempt of vice will be greater in proportion to the scarcity of it: for one villain gives countenance and support to another, just as iron sharpeneth iron. This opens to our view another fact connected with the practice of Christianity, namely, that the nearer it arrives to its perfect state, it will be the more rapid in its progress. The beauty of holiness will be more visible; and, in the strong language of the prophet, "the earth shall bring forth in one day, and a nation shall be born at once *." This future perfection of the gospel is consistent with its nature and importance.—We can scarcely believe that means so admirably adapted to the reformation of mankind should be without their effect; and if the most difficult part be already accomplished, we have no reason to apprehend that the scheme will not be completed. This fact is also clearly the subject of ancient propheey. For "thus saith the Lord †, I will extend peace to her like a river, and the glory of the Gentiles like a flowing stream. And it shall come to pass, from one sabbath to another, and from one new moon to another, shall all flesh come to worship before me, saith the Lord."—"Violence shall be no more heard in thy land, wasting nor destruction within thy border; but thou shalt call thy walls salvation, and thy gates praise." (Is. lx. 18.).

* Is. lxvi. 8.

† Ver. 12. 23.

Millennium Millepora.

Without entering more minutely on the prophecy already quoted from chap. xx. of the book of the Revelation, it is sufficient to observe, that Dr Whitby, in his treatise on the millennium at the end of his commentary, proves, in the clearest manner, from the spirit of the passage and the similarity of the expressions with those of other prophets, that it refers to a state of the church for a thousand years, which shall be like life from the dead. The commencement of this period is connected with two events: the fall of antichrist, and the conversion of the Jews. The latter of these events must be considered as a key to all the prophecies concerning the millennium. As the Jews were the ancient people of God, and as their conversion is to be the previous step to the general knowledge of Christianity, the prophecies of the millennium have a chief relation to this important event. We have already observed, that God never interposes with miraculous power to produce what can be effected by natural means; and from what we know of human nature, we cannot but perceive that the conversion of the Jews will powerfully operate to the general conversion of mankind. Freed from those prejudices which now make them the objects of hatred in all nations, and fired with that zeal by which new converts are always actuated, they will preach the gospel with a fervour of which we, who have long been blessed with its rays, can hardly form a conception; and, by their present dispersion over the whole earth, they will be enabled to adapt their instructions to every individual of the human race in the language of his fathers. Indeed, if they are not at some future period to be employed by Providence for this purpose, it is difficult, if not impossible, to give any reason for their dispersed state and political existence. Just now it must be confessed that they are the most implacable enemies of the Christian name; but their conversion is not on that account more unlikely or improbable than were events which have taken place of nearly equal importance a very few years ago. On the whole, the perfection of Christianity is a doctrine of reasonable expectation to the church; and it is impossible for the advocates for natural religion to deny, that unlimited obedience to its precepts is consistent with the purest state of liberty and of happiness. This is the only millennium which the prophets and apostles, as we understand them, promise to the saints; but as men figuring in the very first ranks of learning have thought otherwise, we would not be too confident that our interpretation is just.—Such of our readers as wish for further information, will find it in the works of Mr Mede, Bishop Newton, Dr Whitby and Dr Gill; and to those masterly writers we refer them for that satisfaction which in such an article as this cannot be given.

MILLEPES, or WOOD-LOUSE; a species of ONISCUS. See ENTOMOLOGY *Index*.

MILLEPORA, in *Natural History*, a name by which Linnæus distinguishes that genus of lithophytes, of a hard structure and full of holes, which are not stellated or radiated, and whose animal is the hydra, in which it differs from the madrepora, and comprehending 14 different species.

In the millepora, the animal which forms and inhabits it occupies the substance; and it is observed that

Millepora || Millot.

the milleporæ grow upon one another; their little animals produce their spawn; which attaching itself either to the extremity of the body already formed, or underneath it, gives a different form to this production. Hence the various shapes of the millepora, which is composed of an infinite number of the cells of those little insects, which all together exhibit different figures, though every particular cellula has its essential form, and the same dimensions, according to its own species.

MILLET. See MILIUM, BOTANY *Index*.

MILLIARE, or MILLIARIUM, a Roman mile, which consisted of 1000 paces, *mille passus*, whence the name.

MILLIARIUM AUREUM, was a gilded pillar in the forum of Rome, at which all the highways of Italy met, as one common centre. From this pillar the miles were counted, and at the end of every mile a stone was put down. The milliary column was erected by Augustus Cæsar, and, as we are informed by travellers, is still to be seen.

MILLING of CLOTH. See FULLING.

MILLION, in *Arithmetic*, the sum of ten hundred thousand, or a thousand times a thousand. See ARITHMETIC.

MILLO, a part of Mount Zion at its extremity; and therefore called *Millo* of the city of David (2 Chron. xxxii.), taken in with the wall that encompassed Mount Zion. Uncertain whether *Beth Millo*, (Judges ix. 20.) denotes a place; if it did, it lay near Sechem.

MILLOT, CLAUDE FRANCIS XAVIER, of the French academy, was born at Besançon, March 1726, and was for some time a Jesuit. He was consecrated for the pulpit, and continued to preach after he left the society: But the weakness of his voice, his timidity, and the awkwardness of his manner, not permitting him to continue in this profession, he relinquished it, although he had preached Advent sermons at Versailles, and Lent sermons at Luneville. The marquis de Felino, minister of Parma, instituted an historical class for the benefit of the young nobility; and, at the desire of M. le Duc de Nivernois, he gave the charge of it to the abbé Millot. The minister having occasioned a kind of rebellion among the people by some innovations which he had made in the state, the abbé continued attached to the interests of his patron, and would not desert him till the storm was blown over. When he was told that he would lose his place by this conduct, he replied, "My place is with a virtuous persecuted man who has been my benefactor; and that I shall never lose." At length, having filled the historical chair with great approbation, he returned to France, and was appointed preceptor to M. le Duc d'Enghien. In this situation he died, A. D. 1785, aged 59. The abbé Millot did not shine in company; he was cold and reserved in his manner; but every thing he said was judicious, and exactly in point.—D'Alembert said, that of all his acquaintance the abbé Millot had the fewest prejudices and the least pretension. He composed several works, which are digested with great care, and written in a pure, simple, and natural style. The principal are, 1. *Elemens de l'Histoire de France, depuis Clovis jusqu' à Louis XIV.* 3 vols. in 12mo. The author, selecting the most curious and important facts, has suppressed every thing foreign to the subject; and has not only arranged the materials in their proper order, but chosen them with the greatest judgment. Querlon thought this the best abridgement which we have of the history of France, and preferred it to that of the president Henault. 2. *Elemens de l'Histoire d'Angleterre depuis son origine sous les Romains, jusqu' à George II.* 3 vols. 12mo. In this valuable abridgement, the author satisfies, without tiring, his readers. It is all that is necessary for those who wish to gain a general knowledge of the English history, without entering minutely into its particular parts.—3. *Elemens de l'Histoire Universelle*, 9 vols. 12mo. A certain critic maintains, that this work is merely a counterfeit of Voltaire's general history. But this censure is altogether unjust. The ancient history in this work is wholly composed by the abbé Millot; and, no less than the modern part, discovers his abilities in the choice of facts, in divesting them of useless circumstances, in relating them without prejudice, and in adorning them with judicious reflections. 4. *L'Histoire des Troubadours*, 3 vols. 12mo, compiled from the manuscripts of M. de Saint Palaie. This work appears rather tedious, because it treats of men almost unknown, and most of them deserving to be so. What is there quoted from the Provençal poets is not at all interesting; and, according to the observation of a man of wit, "it serves no purpose to search curiously into a heap of old ruins while we have modern palaces to engage our attention." 5. *Memoires Politiques et Militaires pour servir à l'Histoire de Louis XIV. et de Louis XV.* composed from original papers collected by Adrian Maurice duc de Noailles, marshal of France, in 6 vols. 12mo. 6. The abbé Millot published also several Discourses, in which he discusses a variety of philosophical questions, with more ingenuity of argument than fire of expression; and a translation of the most select harangues in the Latin historians; of which it has been remarked, as well as of the orations of the abbé d'Olivet, that they are coldly correct, and elegantly insipid. The character of the author, more prudent and circumspect than lively and animated, seldom elevated his imagination above a noble simplicity without warmth, and a pure style without ostentation. Some of the critics, however, have accused him of declamation in some parts of his histories, particularly in those parts which concern the clergy. But, in our opinion, the word declamation is totally inapplicable to the writings of the abbé Millot. He flatters, it is true, neither priests nor statesmen; and he relates more instances of vicious than virtuous actions, because the one are infinitely more common than the other: But he relates them coldly; and he appears to be guided more by sincerity and a love of truth, than by that partial philosophy which blames the Christian religion for those evils which it condemns.

Millot, Milo.

MILO, a celebrated athlete of Crotona in Italy. His father's name was Diotimus. He early accustomed himself to carry the greatest burdens, and by degrees became a prodigy of strength. It is said that he carried on his shoulders a young bullock, four years old, for above forty yards; and afterwards killed it with one blow of his fist, and eat it up in one day. He was seven times crowned at the Pythian games, and six at the Olympian. He presented himself a seventh time; but no one had the courage or boldness to enter the lists against

Milo. against him. He was one of the disciples of Pythagoras; and to his uncommon strength, it is said, the learned preceptor and his pupils owed their life: The pillar which supported the roof of the school suddenly gave way; but Milo supported the whole weight of the building, and gave the philosopher and his auditors time to escape. In his old age, Milo attempted to pull up a tree by the roots, and break it. He partly effected it; but his strength being gradually exhausted, the tree when half cleft re-united, and his hands remained pinched in the body of the tree. He was then alone; and, being unable to disentangle himself, he was devoured by the wild beasts of the place, about 500 years before the Christian era.

Milo, *T. Annius*, a native of Lanuvium, who attempted to obtain the consulship at Rome by intrigue and seditious tumults. Clodius the tribune opposed his views; yet Milo would have succeeded but for the following event: As he was going into the country, attended by his wife and a numerous retinue of gladiators and servants, he met on the Appian road his enemy Clodius, who was returning to Rome with three of his friends and some domesties completely armed.—A quarrel arose between the servants. Milo supported his attendants, and the dispute became general.—Clodius received many severe wounds, and was obliged to retire to a neighbouring cottage. Milo pursued his enemy in his retreat, and ordered his servants to despatch him. The body of the murdered tribune was carried to Rome, and exposed to public view. The enemies of Milo inveighed bitterly against the violence and barbarity with which the sacred person of a tribune had been treated. Cicero undertook the defence of Milo; but the continual clamours of the friends of Clodius, and the sight of an armed soldiery, which surrounded the seat of judgment, so terrified the orator, that he forgot the greatest part of his arguments, and the defence he made was weak and injudicious.—Milo was condemned, and banished to Massilia. Cicero soon after sent his exiled friend a copy of the oration which he had prepared for his defence, in the form in which we have it now; and Milo, after he had read it, exclaimed, *O Cicero, hadst thou spoken before my accusers in these terms, Milo would not be now eating figs at Marseilles.* The friendship and cordiality of Cicero and Milo were the fruits of long intimacy and familiar intercourse. It was to the successful labours of Milo that the orator was recalled from banishment, and restored to his friends.

Milo, (anciently *Melos*), an island in the Archipelago, about 50 miles in circumference, with a harbour, which is one of the largest in the Mediterranean. The principal town is of the same name as the island, and was prettily built, but abominably nasty: the houses are two stories high, with flat roofs; and are built with a sort of pumice stone, which is hard, blackish, and yet very light.

This island was formerly rich and populous. From the earliest times of antiquity it enjoyed pure liberty. The Athenians, not being able to persuade the Melians to declare in their favour in the Peloponnesian war, made a descent upon the island, and attacked them vigorously. In two different expeditions they failed of their purpose: but returning with more numerous forces, they laid siege to Melos; and obliging the besieged to surrender at discretion, put to the sword all the men who were able to bear arms. They spared only the women and children, and these they carried into captivity. This act of cruelty puts humanity to the blush, and disgraces the Athenian name. But war was then carried on with a degree of wild rage, unexampled in the present times. Republics know not how to pardon, and always carry their vengeance to an extravagant height. When Lysander, the Lacedæmonian general, came to give law to the Athenians, he expelled the colony which they had sent to Melos, and re-established the unfortunate remains of its original inhabitants. Milo.

This island lost its liberty when Rome, aspiring to the empire of the world, conquered all the isles of the Archipelago. In the partition of the empire, it fell to the share of the eastern emperors, was governed by particular dukes, and was at last conquered by Soliman II. Since that period, it has groaned under the yoke of Turkish despotism, and has lost its opulence and splendour. At the commencement of the present century, it boasted of 17 churches and 11 chapels, and contained more than 20,000 inhabitants. It was very fertile in corn, wine, and fruits; and the whole space from the town to the harbour, which is nearly two miles, was laid out in beautiful gardens. M. Tournefort, who visited it in the year 1700, gives a fine description of it. "The earth, being constantly warmed by subterraneous fires, produced almost without interruption plenteous crops of corn, barley, cotton, exquisite wines, and delicious melons. St Elias, the finest monastery in the island, and situated on the most elevated spot, is encircled with orange, citron, cedar, and fig trees. Its gardens are watered by a copious spring. Olive trees, of which there are but few in the other parts of the island, grow in great numbers around this monastery. The adjacent vineyards afford excellent wine. In a word, all the productions of the island are the very best of their kinds; its partridges, quails, kids, and lambs, are highly valued, and yet may be bought at a very cheap price."

Were M. Tournefort to return to Milo, M. Savary assures us, he would no longer see the fine island which he has described. "He might still see alum, in the form of feathers, and fringed with silver thread, hanging from the arches of the caverns; pieces of pure sulphur filling the cliffs of the rocks; a variety of mineral springs; hot baths (though these are now only a set of small dirty caves); the same subterraneous fires which in his days warmed the bosom of the earth, and were the cause of its extraordinary fertility: but instead of 5000 Greeks, all paying the capitation tax (A), he would now find no more than about 700 inhabitants

* *Letters on Greece*, Let. xlii.

(A) Grown up men are the only persons who pay the capitation tax. Therefore, by adding to the number of 5000 who paid the tax, the women, boys, and girls, we find that Melos, in the days of Tournefort, contained at least 20,000 souls.

Milo. inhabitants on an island 18 leagues in circumference. He would sigh to behold the finest lands lying uncultivated, and the most fertile valleys converted into morasses; of the gardens scarcely a vestige is left; three-fourths of the town in ruins, and the inhabitants daily decreasing. In short, during the last 50 years, Melos has assumed a quite different appearance. The plague, which the Turks propagate everywhere, has cut off one part of its inhabitants; the injudicious administration of the Porte, and the oppressive extortions of the captain-pacha, have destroyed the rest. At present, for want of hands, they cannot cut out a free channel for their waters, which stagnate in the valleys, corrupt, and infect the air with their putrid exhalations. The salt marshes, of which there are numbers in the island, being equally neglected, produce the same effects. Add to these inconveniences, those sulphureous exhalations which arise all over the island, and by which the inhabitants of Melos are afflicted with dangerous fevers during three-fourths of the year. Perhaps they may be obliged to forsake their country. Every countenance is yellow, pale, and livid; and none bears any marks of good health. The prudent traveller will be careful to spend but a very short time in this unwholesome country, unless he chooses to expose himself to the danger of catching a fever. To sleep over night, or to spend but one day in the island, is often enough to occasion his being attacked with that distemper.

"Yet (continues our author) a judicious and enlightened government might expel those evils which ravage Melos. Its first care would be to establish a lazaret, and to prohibit vessels whose crews or cargoes are infected with the plague from landing. Canals might next be cut, to drain the marshes whose exhalations are so pernicious. The island would then be repeopled. The sulphureous vapours are not the most noxious. These prevailed equally in ancient times, yet the island was then very populous. M. Tournefort, who travelled through it at a time less distant from the period when it was conquered by the Turks, and when they had not yet had time to lay it waste, reckons the number of its inhabitants (as we have said) at about 20,000. The depopulation of Melos is therefore to be ascribed to the despotism of the Porte, and its detestable police."

Sutherland's Tour up the Straits, p. 146.

The women of Milo, once so celebrated for their beauty, are now sallow, unhealthy, and disgustingly ugly; and render themselves still more hideous by their dress, which is a kind of loose jacket, with a white coat and petticoat, that scarcely covers two-thirds of their thighs, barely meeting the stocking above the knee. Their hind hair hangs down the back in a number of plaits; that on the fore part of the head is combed down each side of the face, and terminated by a small stiff curl, which is even with the lower part of the cheek. All the inhabitants are Greeks, for the Turks are not fond of trusting themselves in the small islands; but every summer the captain bashaw goes round with a squadron to keep them in subjection, and to collect the revenue. When the Russians made themselves masters of the Archipelago, many of the islands declared in their favour; but being abandoned by the peace, they were so severely mulcted by the grand signior, that they have professed a determination to remain perfectly quiet in future. As the Turks, however, do not think them worth a garrison, and will not trust them with arms and ammunition, all those which the Russians may choose to invade will be obliged to submit. The two points which form the entrance of the harbour, crossing each other, render it imperceptible until you are close to it. Thus, while you are perfectly secure within it, you find great difficulty in getting out, particularly in a northerly wind; and as no trade is carried on except a little in corn and salt, Milo would scarcely ever be visited, were it not that, being the first island which one makes in the Archipelago, the pilots have chosen it for their residence. They live in a little town on the top of a high rock, which, from its situation and appearance, is called the *Castle*.—Partridges still abound in this island; and are so cheap, that you may buy one for a charge of powder only. The peasants get them by standing behind a portable screen, with a small aperture in the centre, in which they place the muzzle of their piece, and then draw the partridges by a call. When a sufficient number are collected, they fire among them, and generally kill from four to seven at a shot; but even this method of getting them is so expensive, from the scarcity of ammunition, that the people can never afford to shoot them, except when there are gentlemen in the island, from whom they can beg a little powder and shot.

Milo || Miltiades

Milo is 60 miles north of Candia; and the town is situated in E. Long. 25. 15. N. Lat. 36. 27.

MILSTONE. See MILLSTONE.

MILT, in *Anatomy*, a popular name for the SPLEEN.

MILT, or *Melt*, in *Natural History*, the soft roe in fishes; thus called from its yielding, by expression, a whitish juice resembling milk. See ROE.

The milt is properly the seed or spermatic part of the male fish. The milt of a carp is reckoned a choice bit. It consists of two long whitish irregular bodies, each included in a very thin fine membrane. M. Petit considers them as the testicles of the fish wherein the seed is preserved; the lower part next the anus, he supposes to be the *vesiculæ seminales*.

MILTHORP, a port town of Westmoreland, at the mouth of the Can, eight miles south from Kendal. It is the only sea port in the county; and goods are brought hither in small vessels from Grange in Lancashire. Here are two paper mills. It has a market on Friday, and a fair on Old May day; and there is a good stone bridge over the river Betha, which runs through the town. Population 1016 in 1811.

MILTIADES, an Athenian captain, son of Cypselus. He obtained a victory in a chariot race at the Olympic games. He led a colony of Athenians to the Chersonesus. The causes of this appointment are striking and singular. The Thracian Dolonci, harassed by a long war with the Absynthians, were directed by the oracle of Delphi to take for their king the first man they met in their return home, who invited them to come under his roof and partake his entertainments. This was Miltiades, whom the appearance of the Dolonci, with their strange arms and garments, had struck. He invited them to his house, and was made acquainted with the commands of the oracle. He obeyed; and when the oracle of Delphi had approved a second time the choice of the Dolonci,

Miltiades. lonci, he departed for the Chersonesus, and was invested by the inhabitants with sovereign power. The first measures he took were to stop the further incursions of the Absynthians, by building a strong wall across the isthmus. When he had established himself at home, and fortified his dominions against foreign invasion, he turned his arms against Lampsacus. His expedition was unsuccessful; he was taken in an ambuscade, and made prisoner. His friend Crœsus king of Lydia was informed of his captivity, and procured his release. He lived a few years after he had recovered his liberty. As he had no issue, he left his kingdom and possessions to Stefagoras the son of Cimon, who was his brother by the same mother. The memory of Miltiades was greatly honoured by the Dolonci, and they regularly celebrated festivals and exhibited shows in commemoration of a man to whom they owed their greatness and preservation.

MILTIADES, the son of Cimon, and brother of Stefagoras mentioned in the preceding article, was some time after the death of the latter, who died without issue, sent by the Athenians with one ship to take possession of the Chersonesus. At his arrival Miltiades appeared mournful, as if lamenting the recent death of his brother. The principal inhabitants of the country visited the new governor to condole with him; but their confidence in his sincerity proved fatal to them. Miltiades seized their persons, and made himself absolute in Chersonesus. To strengthen himself, he married Hegesipyla, the daughter of Olorus the king of the Thracians. His triumph was short. In the third year of his government, his dominions were threatened by an invasion of the Scythian Nomades, whom Darius had some time before irritated by entering their country. He fled before them; but as their hostilities were of short duration, he was soon restored to his kingdom. Three years after, he left Chersonesus; and set sail for Athens, where he was received with great applause. He was present at the celebrated battle of MARATHON; in which all the chief officers ceded their power to him, and left the event of the battle to depend upon his superior abilities. He obtained an important victory over the more numerous forces of his adversaries. Some time after, Miltiades was intrusted with a fleet of 70 ships, and ordered to punish those islands which had revolted to the Persians. He was successful at first, but a sudden report that the Persian fleet was coming to attack him, changed his operations as he was besieging Paros. He raised the siege, and returned to Athens. He was accused of treason, and particularly of holding correspondence with the enemy. The falsity of these accusations might have appeared, if Miltiades had been able to come into the assembly. But a wound which he had received before Paros detained him at home; and his enemies, taking advantage of his absence, became more eager in their accusations, and louder in their clamours. He was condemned to death; but the rigour of his sentence was retracted on the recollection of his great services to the Athenians, and he was put into prison till he had paid a fine of 50 talents to the state. His inability to discharge so great a sum detained him in confinement; and his wounds becoming incurable, he died a prisoner about 489 years before the Christian era. His body was ransomed by his son Cimon; who was obliged to borrow and pay the 50 talents, to give his father a decent burial.—The accusations against Miltiades were probably the more readily believed by his countrymen, when they remembered how he made himself absolute in Chersonesus; and in condemning the barbarity of the Athenians towards a general, who was the source of their military prosperity, we must remember the jealousy which ever reigns among a free and independent people, and how watchful they are in defence of the natural rights which they see wrested from others by violence. Cornelius Nepos has written the life of Miltiades the son of Cimon; but his history is incongruous and unintelligible, from his confounding the actions of the son of Cimon with those of the son of Cypselus. Greater reliance is to be placed on the narration of Herodotus, whose veracity is confirmed, and who was indisputably better informed and more capable of giving an account of the life and exploits of men who flourished in his age, and of which he could see the living monuments. Herodotus was born about six years after the famous battle of Marathon: and C. Nepos, as a writer of the Augustan age, flourished about 450 years after the age of the father of history. Miltiades, Milton.

MILTON, JOHN, the most illustrious of the English poets, was descended of a genteel family, seated at a place of their own name, viz. *Milton*, in Oxfordshire. He was born December 9. 1608, and received his first rudiments of education under the care of his parents, assisted by a private tutor. He afterwards passed some time at St Paul's school, London; in which city his father had settled, being engaged in the business of a scrivener. At the age of 17, he was sent to Christ's college, Cambridge; where he made great progress in all parts of academical learning; but his chief delight was in poetry. In 1628, he proceeded bachelor of arts, having performed his exercise for it with great applause. His father designed him for the church; but the young gentleman's attachment to the Muses was so strong, that it became impossible to engage him in any other pursuits. In 1632, he took the degree of master of arts; and having now spent as much time in the university as became a person who determined not to engage in any of the three professions, he left the college, greatly regretted by his acquaintance, but highly displeased with the usual method of training up youth there for the study of divinity; and being much out of humour with the public administration of ecclesiastical affairs, he grew dissatisfied with the established form of church government, and disliked the whole plan of education practised in the university. His parents, who now dwelt at Horton, near Colnbrook, in Buckinghamshire, received him with unabated affection, notwithstanding he had thwarted their views of providing for him in the church, and they amply indulged him in his love of retirement; wherein he enriched his mind with the choicest stores of Grecian and Roman literature; and his poems of *Comus*, *l'Allegro*, *Il Penseroso*, and *Lycidas*, all wrote at this time, would have been sufficient, had he never produced any thing more considerable, to have transmitted his fame to the latest posterity. However, he was not so absorbed in his studies as not to make frequent excursions to London; neither did so much excellence

pass

Milton. pass unnoticed among his neighbours in the country, with the most distinguished of whom he sometimes chose to relax his mind, and improve his acquaintance with the world as well as with books.—After five years spent in this manner, he obtained his father's permission to travel for farther improvement. At Paris he became acquainted with the celebrated Hugo Grotius; and from thence travelling into Italy, he was everywhere caressed by persons of the most eminent quality and learning.

Upon his return home, he set up a genteel academy in Aldersgate street.—In 1641, he began to draw his pen in defence of the Presbyterian party; and the next year he married the daughter of Richard Powell, Esq. of Forest Hill in Oxfordshire. This lady, however, whether from a difference on account of party, her father being a zealous royalist, or some other cause, soon thought proper to return to her relations; which so incensed her husband, that he resolved never to take her again, and wrote and published several tracts in defence of the doctrine and discipline of divorce. He even made his addresses to another lady; but this incident proved the means of a reconciliation with Mrs Milton.

In 1644, he wrote his Tract upon Education; and the restraint on the liberty of the press being continued by act of parliament, he wrote boldly and nobly against that restraint. In 1645, he published his juvenile poems; and about two years after, on the death of his father, he took a smaller house in High Holborn, the back of which opened into Lincoln's-Inn Fields.—Here he quietly prosecuted his studies, till the fatal catastrophe and death of Charles I.; on which occasion he published his Tenure of Kings and Magistrates, in justification of the fact. He was now taken into the service of the commonwealth, and made Latin secretary to the council of state, who resolved neither to write to others abroad, nor to receive any answers, except in the Latin tongue, which was common to them all. The famous Εικων Βατιλικη coming out about the same time, our author, by command, wrote and published his *Iconoclastes*, the same year. It was also by order of his masters, backed by the reward of 1000l. that in 1651 he published his celebrated piece, entitled *Pro Populo Anglicano Defensio*; "A Defence of the people of England," in answer to Salmasius's Defence of the King; which performance spread his fame over all Europe. He now dwelt in a pleasant house with a garden in Petty France, Westminster, opening into St James's Park. In 1652 he buried his wife, who died not long after the delivery of her fourth child; and about the same time he also lost his eye-sight, by a *gutta serena*, which had been growing upon him many years.

Cromwell took the reins of government into his own hand in the year 1653; but Milton still held his office. His leisure hours he employed in prosecuting his studies; wherein he was so far from being discouraged by the loss of his sight, that he even conceived hopes this misfortune would add new vigour to his genius; which in fact seems to have been the case.—Thus animated, he again ventured upon matrimony: his second lady was the daughter of Captain Woodstock of Hackney: she died in childbed about a year after. On the deposition of the protector, Richard Cromwell, and on the return of the long parliament, Milton being still continued secretary, he appeared again in print; pleading for a farther reformation of the laws relating to religion; and, during the anarchy that ensued, he drew up several schemes for re-establishing the commonwealth, exerting all his faculties to prevent the return of Charles II. England's destiny, however, and Charles's good fortune prevailing, our author chose to consult his safety, and retired to a friend's house in Bartholomew Close. A particular prosecution was intended against him; but the just esteem to which his admirable genius and extraordinary accomplishments entitled him, had raised him so many friends, even among those of the opposite party, that he was included in the general amnesty. Milton.

This storm being over, he married a third wife, Elizabeth, daughter of Mr Minshall a Cheshire gentleman; and not long after he took a house in the Artillery Walk, leading to Bunhill Fields. This was his last stage: here he sat down for a longer continuance than he had been able to do anywhere; and though he had lost his fortune (for every thing belonging to him went to wreck at the Restoration), he did not lose his taste for literature, but continued his studies with almost as much ardour as ever; and applied himself particularly to the finishing his grand work, the *Paradise Lost*; one of the noblest poems that ever was produced by human genius. —It was published in 1667, and his *Paradise Regained* came out in 1670.—This latter work fell short of the excellence of the former production; although, were it not for the transcendent merit of Paradise Lost, the second composition would doubtless have stood foremost in the rank of English epic poems. After this he published many pieces in prose; for which we refer our readers to the edition of his Historical, Poetical, and Miscellaneous Works, printed by Millar, in 2 vols. 4to, in 1753.

In 1674, this great man paid the last debt to nature at his house in Bunhill Fields, in the 66th year of his age; and was interred on the 12th of November, in the chancel of St Giles's, Cripplegate.—A decent monument was erected to his memory, in 1737, in Westminster Abbey, by Mr Benson, one of the auditors of the imprest.—Milton was remarkably handsome in his person; but his constitution was tender, and by no means equal to his incessant application to his studies. —Though greatly reduced in his circumstances, yet he died worth 1500l. in money, besides his household goods.—He had no son: but left behind him three daughters, whom he had by his first wife.

Milton, the name of several places in England; particularly,

Milton, or *Middleton*, in Dorsetshire, south-west of Blandford, near the road to Dorchester, 114 miles from London. It is chiefly noted for its abbey, built by King Athelstan. The church stands near the south side of the abbey. It is a large and magnificent pile of Gothic architecture, and contains several ancient monuments. Here is an almshouse for six people, who have 12s. a-week, and three yards of cloth for a gown, one pair of shoes and stockings, and 10s. each, on St Thomas's day yearly. Here is a free school, and a market on Tuesdays.

Milton, in Kent, near Sittingbourn and the isle of Sheppey, 6 miles north-west of Feversham, and 40 from

Milton || Mimnermus.

from London. It is also called *Middleton* from its situation near the middle of the county, i. e. from Deptford to the Downs. The kings of Kent had a palace here, which was castellated, and stood below the church; but was burnt down in Edward the Confessor's time by Earl Goodwin, &c. Its church stands near a mile off. On approaching the town up the Thames, by the East Swale, it seems hid among the creeks: yet it is a large town; and has a considerable market on Saturdays, and a fair on July 24. The oysters taken here are the most famous of any in Kent. This town is governed by a portreeve, chosen yearly on St James's day, who supervises the weights and measures all over the hundred. Population 2470 in 1811.

MILTON, in Kent, a mile on the east side of Gravesend, was incorporated with it in the reign of Queen Elizabeth, by the name of the portreeve, jurats, and inhabitants of the towns of Gravesend and Milton. King Henry VIII. raised a platform or blockhouse here, for the defence both of this town and Gravesend, and the command of the river. It has a fair, January 25.

MILVIUS, MOLVIUS, or MULVIUS, *Pons;* a bridge on the Tiber, built by Æmilius Scaurus the censor, in the time of Sylla, at two miles distance from the city, on the Via Flaminia, and repaired by Augustus. From this bridge the ambassadors of the Allobroges were brought back to Rome, by Cicero's management, and made a discovery of Catiline's conspiracy (Sallust). Near it Maxentius was defeated by Constantine (Eutropius). Now called *Ponte Molle.*

MILVIUS, a species of FALCO. See FALCO, ORNITHOLOGY *Index.*

MIMI, MIMES, in the ancient comedy, were buffoons or mimics, who entertained the people by taking off certain characters, using such gestures as suited the persons or subjects they represented. There were on the Roman stage female performers of this kind, called *mimæ.* The word is derived from μιμεομαι, *I imitate.* Some of the *mimi* acted their parts to the sound of the *tibia;* these they called *mimauli.*

MIMI were also a kind of farces or ludicrous comedies, generally performed by one person. They had no acts, nor any *exordium.*—The *mimi* were introduced upon the Roman stage long after comedy and tragedy had arrived at their full perfection. The actor wore no mask, but smeared his face with soot, was dressed in lambskin, wore garlands of ivy, and carried a basket of flowers and herbs, in honour of Bacchus, and diverted the audience with apish tricks and ridiculous dances. This was the state of the *mimi* soon after their first introduction; but they underwent many alterations, which it would take up too much room to relate, and which are not of sufficient importance to justify a detailed account. See PANTOMIMES.

MIMESIS, in *Rhetoric*, the imitating the voice and gestures of another person.

MIMNERMUS, an ancient poet and musician, flourished about the beginning of the sixth century B. C. He was of Smyrna, and cotemporary with Solon. Athenæus gives him the invention of pentameter verse. His elegies, of which only a few fragments are preserved, were so much admired in antiquity, that Horace preferred them to those of Callimachus. He composed a poem of this kind, as we learn from Pausanias, upon the battle fought between the people of Smyrna, and the Lydians under Gyges. He likewise was author of a poem in elegiac verse, quoted by Strabo, which he entitled *Nanno*, and in which we may suppose he chiefly celebrated a young and beautiful girl of that name, who, according to Athenæus, was a player on the flute, with whom he was enamoured in his old age. With respect to love matters, according to Propertius, his verses were more valuable than all the writings of Homer.

Mimnermus || Minagnghinim

Plus in amore valet Mimnermi versus Homero.
Lib. I. Eleg. ix. v. 11.

And Horace bears testimony to his abilities in describing that seducing passion:

Si Mimnermus uti censet, sine amore jocisque
Nil est jucundum, vivas in amore jocisque.
Lib. I. Epist. vi. v. 65.

If, as wise Mimnermus said,
Life unblest with love and joy
Ranks us with the senseless dead,
Let these gifts each hour employ.

Alluding to some much admired lines of the Greek poet, which have been preserved by Stobæus.

Τις δε βιος, τι δε τερπνον ατης χρυσης Αφροδιτης, &c.

What is life and all its pride,
If love and pleasure be denied?
Snatch, snatch me hence, ye Fates, whene'er
The am'rous bliss I cease to share.
Oh let us crop each fragrant flow'r
While youth and vigour give us pow'r:
For frozen age will soon destroy
The force to give or take a joy;
And then, a prey to pain and care,
Detested by the young and fair,
The sun's best beams will hateful grow,
And only shine on scenes of wo.

MIMOSA, the SENSITIVE PLANT, a genus of plants belonging to the monœcia class; and in the natural method ranking under the 33d order, *Lomentacea*. See BOTANY and MATERIA MEDICA *Index.*

The name *mimosa*, signifying "mimic," is given to this genus on account of the sensibility of the leaves, which, by their motion, mimic or imitate, as it were, the motion of animals.

MINA, or MANEH, a species of money which properly signifies *one part* or *ounce*. It is observed that this word occurs only in the books of Kings, Chronicles, Ezra, and Ezekiel. This prophet (xlv. 12.) tells us, that the mina or maneh was valued at 60 shekels, which in gold make of our English money about 54½ pounds, and in silver almost seven pounds. Thus for the Hebrew maneh. But the Greek or Attic mina, which is probably that mentioned in the books of the Maccabees and in the New Testament, is valued at 100 drachmæ, or about 2l. 17s. sterling. There was also a lesser mina, which was valued at 75 drachmæ.

MINAGNGHINIM, a pulsative instrument of music, among the Hebrews, which was a square table of wood, fitted with a handle; over this table was

Minagnghinin || Mindanao.

stretched an iron chain, or hempen cord, passing through balls of wood or brass, which struck against the table, when the instrument was shaken, and occasioned a clear sound, which might be heard at a great distance.

MINCHA, in the Jewish customs, offerings of meal, cakes, or biscuits, made in the temple of the Lord. The Seventy have sometimes preserved this word in their translation; but instead of *mincha* they read *manaa*, which doubtless was the received pronunciation in their time. We find *manaa* in the same sense, in Baruch i. 10. Levit. ii. 3. &c. See the Greek of Jerem. xvii. 26. Dan. ii. 46. 2 Kings viii. 5. 9. xvii. 7. xx. 12. 2 Chron. vii. 7. Nehem. xiii. 5. 9. &c.

MINCHING-HAMPTON, a town of Gloucestershire, 20 miles from Bath and Bristol, and near 90 from London, with a market on Tuesdays, and two fairs. The parish is pretty large, being bounded on the north by the Stroud, and on the south by the brook Avening; and has 12 hamlets belonging to it, with a common called Amberley. Here is a good large rectory church, built in form of a cross. In 1811 the inhabitants amounted to 3246, many of whom are employed in the woollen manufacture. W. Long. 2. 14. N. Lat. 51. 38.

MINCIUS, a river of the Transpadana in Italy; running from, or rather transmitted through, the Lacus Benacus, from north to south, into the Padus; but originally rising in the Rhetian Alps. Now Mincio or Menzo, running through the duchy of Mantua into the Po.

MIND, a thinking intelligent being, otherwise called *spirit*, in opposition to matter or body. See METAPHYSICS, Part III.

MINDANAO, or MAGINDANAO, a large island of Asia in the East Indies, and one of the Philippines; 160 miles in length, and 120 in breadth. The interior parts contain several chains of lofty mountains, between which are extensive plains, where vast herds of cattle roam at large in the most delicious pastures. Several deep valleys also intersect, as it were, certain parts of the country, through which, during the rainy seasons, vast torrents pour from the mountains, and force their impetuous way to the sea. The rains and vapours which lodge in the plains diffuse themselves into meandering rivulets, and, collecting a variety of small streams in their course, approach the sea in the form of considerable rivers.—The sovereign of Magindanao is a powerful prince, and has several inferior chiefs, who acknowledge him as their head. Nevertheless, there are others of them who refuse submission to him, and are consequently in a continual state of war; so that peace, at least, does not appear to be one of the blessings of this island. The Spaniards, indeed, assert their right to the entire dominion of Magindanao; but it is mere assertion; for though they have forts, &c. on the island, it is by no means in a state of subjection to their nation.

The air is esteemed salubrious, particularly in the vicinity of the sea. The heat there is not, in any degree, so intense as might be expected in a country which is situated on the very verge of the torrid zone. The prevalence of the easterly winds, in that part of the coasts which is washed by the Pacific ocean, renders the air cool and pleasant, the trade wind blowing incessantly on its shores. It acts, indeed, with so much power as to sweep the whole breadth of the island; and though in its passage it loses much of its strength, it retains a sufficient degree of force to afford refreshing breezes to the inhabitants of the western shore. The interior parts are much colder, from a very cloudy atmosphere, which frequently hangs over the summits of the mountains in thick and humid vapours. The soil, which is very exuberant, is suited to the cultivation of the whole vegetable tribes. Rice is produced in the greatest abundance; a pecul, or 133 pounds, may be purchased for a Spanish dollar. Every part of the island abounds with buffaloes, cows, hogs, goats, &c. It affords also great variety of fowls, and a species of duck, whose head is of a fine scarlet colour. Here is also a small breed of horses, remarkable for their spirit. The natives, however, principally employ buffaloes in the various branches of husbandry and agriculture.

Mindanao || Minden.

The city of Magindanao is situated on the south-east side of the island, has a river capable of admitting small vessels, and carries on a considerable trade with Manilla, Sooloo, Borneo and the Moluccas. Their exports are rice, tobacco, bees wax, and spices; in return for which they receive coarse cloths of Coromandel, China ware, and opium. The village or town of Samboingan is situated on the banks of a small rivulet, which empties itself immediately into the sea, and is agreeably shaded by groves of cocoa trees. The number of its inhabitants is about 1000, among which are included the officers, soldiers, and their respective families. In its environs there are several small look-out houses, erected on posts of twelve feet high, in all of which a constant guard is kept; so that it appears as if the Spaniards were in a continual state of enmity with the natives. The houses are built of those simple materials which are of very general use in the eastern seas. They are erected on posts, and built of bamboo, covered with mats; the lower apartments serve for their hogs, cattle, and poultry, and the upper ones are occupied by the family.

MINDELHEIM, a town of Germany, in the circle of Suabia, and in Algow, with a castle. It is capital of a small territory between the rivers Iller and Lech, subject to the house of Bavaria. It was taken by the Imperialists after the battle of Hochstet, who erected it into a principality in favour of the duke of Marlborough; but it returned back to the house of Bavaria by the treaty of Rastadt. It is 33 miles south-east of Ulm. E. Long. 10. 40. N. Lat 48. 5.

MINDELHEIM, a district of Germany, in Suabia, lying between the bishoprick of Augsburg and the abbacy of Kempten, which is 20 miles in length and 16 in breadth.

MINDEN, a considerable town of Germany, in the circle of Westphalia; and capital of a territory of the same name; seated on the river Weser, which renders it a trading place. It formerly belonged to the king of Prussia, who secularized the bishoprick. It is 27 miles east by south of Osnaburg, and 37 west of Hanover. E. Long. 9. 5. N. Lat. 52. 22.

MINDEN (the principality of), in Germany, lies in the circle of Westphalia, to the north of the county of Ravensburg, and along each side of the river Weser.

It

Minden || Mine

It is about 22 miles square, and Minden and Petershagen are the principal places. It was formerly a bishoprie, but is now secularized; was afterwards ceded to the elector of Brandenburg, and is now annexed to the new kingdom of Westphalia.

MINDORA, an island of Asia, in the East Indies, and one of the Philippines, 50 miles in circumference, and separated from Luconia by a narrow channel. It is full of mountains, which abound in palm trees and all sorts of fruits. The inhabitants are idolaters, and pay tribute to the Spaniards, to whom this island belongs.

MINE, in *Natural History*, a deep pit under ground, from whence various kinds of minerals are dug out; but the term is more particularly applied to those which yield metals. Where stones only are procured, the appellation of *quarries* is universally bestowed upon the places from which they are dug out, however deep they may be.

The internal parts of the earth, as far as they have been yet investigated, do not consist of one uniform substance, but of various *strata* or beds of substances, extremely different in their appearances, specific gravities, and chemical qualities, from one another. Neither are these strata similar to one another either in their nature or appearance in different countries; so that even in the short extent of half a mile, the strata will be found quite different from what they are in another place. As little are they the same either in depth or solidity. Innumerable cracks and fissures, by the miners called *lodes*, are found in every one of them; but these are so entirely different in size and shape, that it is impossible to form any inference from their size in one place to that in another. In these lodes or fissures the metallic ore is met with; and, considering the great uncertainty of the dimensions of the lodes, it is evident that the business of mining, which depends on that size, must in like manner be quite uncertain and precarious. Mr Price, in his treatise on the Cornish mines, observes, that "the comparative smallness of the largest fissures to the bulk of the whole earth is really wonderful. In the finest pottery we can make, by a microscopic view, we may discover numerous cracks and fissures, so small as to be impenetrable by any fluid, and impervious to the naked eye; as, by the laws of nature originally imposed by the Creator, it happens that matter cannot contract itself into solid large masses, without leaving fissures between them, and yet the very fissures are as necessary and useful as the strata through which they pass. They are the drains that carry off the redundant moisture from the earth; which, but for them, would be too full of fens and bogs for animals to live or plants to thrive on. In these fissures, the several ingredients which form *lodes*, by the continual passing of waters, and the menstrua of metals, are brought out of the adjacent strata, collected and conveniently lodged in a narrow channel, much to the advantage of those who search for and pursue them; for if metals and minerals were more dispersed, and scattered thinly in the body of the strata, the trouble of finding and getting at them would be endless, and the expence of procuring them exceed the value of the acquisition.

The insides of the fissures are commonly coated over with a hard, crystalline, earthy substance or rind, which very often, in the breaking of hard ore, comes off along with it, and is commonly called the *capels* or *walls* of the lode: but Mr Price is of opinion, that the proper walls of the lode are the sides of the fissure itself, and not the coat just mentioned, which is the natural plaster upon those walls, furnished perhaps by the contents of the fissures, or from oozings of the surrounding strata. Mine

The breadth of a lode is easily known by the distance betwixt the two incrusted sides of the stones of ore; and if a lode yields any kind of ore, it is a better sign that the walls be regular and smooth, or at least that one of them be so, than otherwise; but there are not many of these fissures which have regular walls until they have been sunk down some fathoms.

Thus the inner part of the fissure in which the ore lies, is all the way bounded by two walls of stone, which are generally parallel to one another, and include the breadth of the vein or lode. Whatever angle of inclination some fissures make in the solid strata at their beginning, they generally continue to do the same all alone. Some are very uncertain in their breadth, as they may be small at their upper part and wide underneath, and *vice versa*. Their regular breadth, as well as their depth, is subject to great variation; for though a fissure may be many fathoms wide in one particular place, yet a little further east or west it may not perhaps be one inch wide. This excessive variation happens generally in very compact strata, when the vein or fissure is squeezed, as it were, through hard rocks which seem to compress and straiten it. A true vein or fissure, however, is never entirely obliterated, but always shows a string of metallic ore or of a veiny substance; which often serves as a leader for the miners to follow, until it sometimes leads them to a large and richly impregnated part. Their length is in a great measure unlimited, though not the space best fitted for yielding metal. The richest state for copper, according to Mr Price, is from 40 to 80 fathoms deep; for tin, from 20 to 60: and though a great quantity of either may be raised at 80 or 100 fathoms, yet, "the quality (says our author) is often too much decayed and dry for metal."

Mr Price informs us, that the fissures or veins of the Cornish mines extend from east to west; or, more properly, one end of the fissure points west and by south, or west and by north; while the other tends east and by south, or east and by north. Thus they frequently pass through a considerable tract of country with very few variations in their directions, unless they be interrupted by some intervening cause.—But, besides this east and west direction, we are to consider what the miners call the *underlying* or *hade* of the vein or lode; viz. the deflection or deviation of the fissure from its perpendicular line, as it is followed in depth like the slope of the roof of a house, or the descent of the steep side of a hill. This slope is generally to the north or south; but varies much in different veins, or sometimes even in the same vein; for it will frequently slope or underlie a small space in different ways, as it may appear to be forced by hard strata on either side.—Some of the fissures do

Mine. not vary much from a perpendicular, while some deviate more than a fathom; that is, for every fathom they descend in perpendicular height, they deviate likewise as much to the south or north. Others differ so much from the perpendicular, that they assume a position almost horizontal; whence they are also called *horizontal* or *flat lodes*, and sometimes *lode plots*. Another kind of these has an irregular position with regard to the rest; widening horizontally for a little way, and then descending perpendicularly almost like stairs, with only a small string or leader to follow after; and thus they alternately vary and yield ore in several flat or horizontal fissures. This, by the Cornish tinners, is called (but in Mr Price's opinion erroneously) a *floor* or *squat;* which, properly speaking, is a hole or chasm impregnated with metal, making no continued line of direction or regular walls. Neither does a floor of ore descend to any considerable depth; for underneath it there appears no sign of a vein or fissure, either leading directly down or any other way. This kind of vein is very rare in Britain. The fissures most common in Britain are the perpendicular and inclined, whether their direction be north or south, east or west.

The perpendicular and horizontal fissures (according to our author) probably remain little altered from their first position, when they were formed at the induration of the strata immediately after the waters left the land. The perpendicular fissures are found more commonly situated in level ground, at a distance from hills, and from the sea shore; but with regard to the latter, we find that the upper and under masses of strata differ in their solidity and other properties. "Hence, (says our author) it is very plain, that inclined fissures owe their deflection or underlie to some secondary cause, violence, or subsidence, of the earth: for though perpendicular fissures are seldom to be seen, yet such as are inclined at very considerable depths, become more and more perpendicular, as the more central strata by reason of the vast superincumbent weight, do not seem so likely to be driven out of their position as those which lie nearer the surface."

The fissures are often met with fractured as well as inclined; the reason of which, in Mr Price's opinion, has been a subsidence of the earth from some extraordinary cause. "The original position (says he) must have been horizontal, or parallel to the surface of the earth: but we often find these strata very sensibly declined from that first position; nay, sometimes quite reversed, and changed into perpendicular. When we see a wall lean, we immediately conclude that the foundation has given way, according to the angles which the walls make with the horizon; and when we find the like declination in strata, we may conclude, by parity of reason, that there has been a like failure of what supported them, in proportion to that declination; or that whatever made the strata to fall so much awry, must also cause ever thing included in those strata to fall proportionally. Wherever the greatest subsidence is to the north, the top of the lode or fissure will point to the north, and of consequence underlie to the south, and *vice versa*: the slide or heave of the lode manifests the greater subsidence of the strata; but the same lode is frequently fractured and heaved in several places, all of which, by due observation, will show us they were occasioned by so many several shocks or subsidencies, and that the strata were not unfooted, shaken, or brought to fall only once or twice, but several times." Mine.

Mr Price, in the course of his work, observes, that, though the metallic veins generally run from east to west, they are frequently intersected by veins or *lodes*, as he calls them, of other matters, which run from north to south. Some of these cross veins contain lead or antimony, but never tin or copper. Sometimes one of these unmetallic veins intersects the true one at right angles, sometimes obliquely; and sometimes the mixture of both is so intimate, that the most expert miners are at a loss to discover the separated part of the true vein. When this last is intercepted at right angles, it is moved either north or south, a very little way, perhaps not more than one fathom; in which case, the miners having worked to a small distance in one of these directions, if they find themselves disappointed, turn to the other hand, and seldom fail of meeting with what they expected. Sometimes they are directed in their search by the pointing of a rib or string of the true vein; but when the interruption happens in an oblique direction, the difficulty of finding the vein again is much greater.

When two metallic veins in the neighbourhood of each other run in an oblique direction, and of consequence meet together, they commonly produce a body of ore at the place where they intersect; and if both are rich, the quantity will be considerable; but if one be poor and the other rich, then both are either enriched or impoverished by the meeting. After some time they separate again, and each will continue its former direction near to the other; but sometimes, though rarely, they continue united.

It is a sign of a poor vein when it separates or diverges into strings; but on the contrary, when several of them are found running into one, it is accounted a promising sign. Sometimes there are branches without the walls of the vein in the adjacent strata, which often come either obliquely or transversely into it. If these branches are impregnated with ore, or if they underlie faster than the true vein, that is, if they dip deeper into the ground, then they are said to overtake or come into the lode, and to enrich it; or if they do not, then they are said to go off from it, and to impoverish it. But neither these nor any other marks either of the richness or poverty of a mine are to be entirely depended upon; for many mines, which have a very bad appearance at first, do nevertheless turn out extremely well afterwards; while others, which in the beginning seemed very rich, turn gradually worse and worse: but in general, where a vein has a bad appearance at first, it will be imprudent to be at much expence with it.

Veins of metal, as has been already observed, are frequently, as it were, so compressed betwixt hard strata, that they are not an inch wide: nevertheless, if they have a string of good ore, it will generally be worth while to pursue them: and they frequently turn out well at last, after they have come into softer ground. In like manner, it is an encouragement to go on if the branches or leaders of ore enlarge either in width or depth as they are worked; but it is a bad sign if they continue horizontal without inclining downwards; though it is not proper always to discontinue the working

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Mine. ing of a vein which has an unfavourable aspect at first. Veins of tin are worth working when only three inches wide, provided the ore be good; and copper ores when six inches wide will pay very well for the working. Some of the great mines, however, have very large veins, with a number of other small ones very near each other. There are also veins, crossing one another sometimes met with, which are called *contras*, vulgarly *caunters*. Sometimes two veins run down into the ground in such a manner that they meet in the direction of their depth; in which case the same observations apply to them which are applicable to those that meet in a horizontal direction. Sometimes a vein will suddenly disappear without giving any warning, by becoming narrower, or of worse quality; which by the miners is called a *start* or *leap*, and is very common in the mines of Cornwall. In one day's time they may thus be disappointed in the working of a rich vein of tin, and have no further sign of any thing to work upon. At the fractured extremity of their vein they perceive a body of clay or other matter; and the method of recovering their vein is to drive on the work in the direction of the former part, so that their new work shall make the same angle with the clay that the other part of the vein does. Sometimes they sink a shaft down from the surface; but it is generally a matter of difficulty to recover a vein when thus lost.

The method of discovering mines is a matter of so much difficulty, that it seems surprising how those who were totally unacquainted with the nature of metals first came to think of digging them out of the earth. According to Lucretius, the discovery was made by the conflagration of certain woods, which melted the veins of metal in the earth beneath them; but this seems rather to be improbable. Aristotle, however, is of the same opinion with Lucretius, and tells us, that some shepherds of Spain having set fire to the woods, the earth was thus heated to such a degree that the silver near the surface of it melted and flowed into a mass; and that in a short time the metallic mass was discovered by the rending of the earth in the time of an earthquake: and the same story is told by Strabo, who ascribes the discovery of the mines of Andalusia to this accident. Cadmus is said by some to have been the first who discovered gold: while others ascribe this to Thoas the Thracian, to Mercury the son of Jupiter, or to Pisus king of Italy; who having left his own country, went into Egypt, where he was elected king after the death of Mizraim the son of Ham; and, on account of his discovery, was called the *Golden God*. Others say, that *Eaclis* or Cæacus the son of Jupiter, or Sol the son of Oceanus, was the first discoverer; but Æschylus attributes the discovery not only of gold, but of all other metals, to Promethens. The brass and copper mines in Cyprus were first discovered by Cinyra the son of Agryopa; and Hesiod ascribes the discovery of the iron mines of Crete to the Cretan Dactyli Idæi. The extraction of lead or tin from its ore in the island of Cassiteris, according to several ancient authors, was discovered by Midaeritus.—The Scripture, however, ascribes the invention of brass and iron, or at least of the methods of working them, to Tubal Cain before the flood.

In more modern times, we know that mines have been frequently discovered by accident; as in sea cliffs, among broken craggy rocks, by the washing of the tide or floods, also by irruptions and torrents of water issuing out of hills and mountains, and sometimes by the wearing of high roads. Mr Price mentions another way by which mines have been discovered, viz. by fiery coruscations; which, he says, he has heard from persons whose veracity he is unwilling to question. "The tinners (says he) generally compare these effluvia to blazing stars or other whimsical likenesses, as their fears or hopes suggest; and search with uncommon eagerness the ground over which these jack-a-lanterns have appeared and pointed out. We have heard but little of these phenomena for many years: whether it be, that the present age is less credulous than the foregoing, or that the ground, being more perforated by innumerable new pits sunk every year, some of which, by the stannary laws, are prevented from being filled up, has given these vapours a more gradual vent, it is not necessary to inquire, as the fact itself is not generally believed."

Mines, however, are now most commonly discovered by investigating the nature of such veins, ores, and stones as may seem most likely to turn to account: but there is a particular sagacity, or habit of judging from particular signs, which can be acquired only by long practice. Mines, especially those of copper, may also be discovered by the harsh and disagreeable taste of the waters which issue from them; though it is probable that this only happens when the ore lies above the level of the water which breaks out; for it does not seem likely that the taste of the ore could *ascend*, unless we were to suppose a pond or lake of water standing above it. The presence of copper in any water is easily discovered by immerging in it a bit of polished iron, which will thus instantly be turned of a copper colour, by reason of the precipitation of the metal upon it. A candle, or piece of tallow put into water of this kind, will in a short time be tinged of a green colour.

Another and still more remarkable method of discovering mines is said to be by the *virgula divinatoria*, or "divining rod;" which, however incredible the stories related concerning it may be, is still relied on by some, and among others by Mr Price. It is not known who was the inventor of this method; but Agricola supposes that it took its rise from the magicians, who pretended to discover mines by enchantment. No mention is made of it, however, before the 11th century, since which time it has been in frequent use; and the Corpuscular Philosophy has even been called in to account for it. But before we pretend to account for phenomena so very extraordinary as those reported of the *virgula divinatoria*, it is necessary, in the first place, to determine whether or not they exist. Mr Price, as has been already hinted, believes in it, though he owns that by reason of his constitution of mind and body, he is almost incapable of co-operating with its influence. The following account, however, he gives from Mr William Cookworthy of Plymouth, a gentleman of known veracity and great chemical abilities.

He had the first information concerning this rod from one Captain Ribeira, who deserted from the Spanish service in Queen Anne's reign, and became captain-commandant in the garrison of Plymouth: in this

Mine. which town he satisfied several intelligent persons of the virtues of the rod, by many experiments on pieces of metal hid in the earth, and by an actual discovery of a copper mine near Oakhampton, which was wrought for some years. This captain very readily showed the method of using the rod in general, but would not by any means discover the secret of distinguishing the different metals by it: though, by a constant attention to his practice, Mr Cookworthy discovered it. Captain Ribeira was of opinion, that the only proper rods for this purpose were those cut from the nut or fruit trees; and that the virtue was confined to certain persons, and those, comparatively speaking, but few: but Mr Price says, that the virtue resides in all persons and in all rods under certain circumstances. "The rod (says he) is attracted by all the metals, by coals, limestone, and springs of water, in the following order: 1. Gold; 2. Copper; 3. Iron; 4. Silver; 5. Tin; 6. Lead; 7. Coals; 8. Limestone and springs of water. One method of determining the different attractions of the rod is this: Stand, holding the rod with one foot advanced; put a guinea under that foot, and an halfpenny under the other, and the rod will be drawn down; shift the pieces of money, and the rod will be drawn towards the face, or backwards to the gold, which proves the gold to have the stronger attraction.

"The rods formerly used were shoots of one year's growth that grew forked; but it is found, that two separate shoots tied together with packthread or other vegetable substance answer rather better than such as are naturally forked, as the shoots of the latter are seldom of an equal size. They are to be tied together by the greater ends, the small ones being held in the hands. Hazle rods cut in the winter, such as are used for fishing rods, and kept till they are dry, do best; though, where these are not at hand, apple-tree suckers, rods from peach trees, currants, or the oak, though green, will answer tolerably well."

Our author next proceeds to describe the manner of holding the rod; of which he gives a figure, as he says it is difficult to be described. The small ends being crooked, are to be held in the hands in a position flat or parallel to the horizon, and the upper part in an elevation not perpendicular to it, but at an angle of about 70 degrees. "The rod (says he) being properly held by those with whom it will answer, when the toe of the right foot is within the semidiameter of the piece of metal or other subject of the rod, it will be repelled towards the face, and continue to be so while the foot is kept from touching or being directly over the subject; in which case it will be sensibly and strongly attracted, and be drawn quite down. The rod should be firmly and steadily grasped; for if, when it has begun to be attracted, there be the least imaginable jerk or opposition to its attraction, it will not move any more till the hands are opened, and a fresh grasp taken. The stronger the grasp the livelier the rod moves, provided the grasp be steady and of an equal strength. This observation is very necessary, as the operation of the rod in many hands is defeated purely by a jerk or counteraction; and it is from thence concluded, that there is no real efficacy in the rod, or that the person who holds it wants the virtue; whereas, by a proper attention to this circumstance in using it, five persons in six have the virtue, as it is called; that is, the nut or fruit-bearing rod will answer in their hands. If a rod, or the least piece of one of the nut-bearing or fruit kind, be put under the arm, it will totally destroy the operation of the *virgula divinatoria*, in regard to all the subjects of it, except water, in those hands in which the rod naturally operates. If the least animal thread, as silk, or worsted, or hair, be tied round or fixed on the top of the rod, it will in like manner hinder its operation; but the same rod placed under the arm, or the same animal substances tied round or fixed on the top of the rod, will make it work in those hands, in which without these additions it is not attracted." Mine.

Such are the accounts of this extraordinary rod, to which it is probable that few will assent; and we believe the instances of mines having been discovered by it are but very rare. Another and very ancient mode of discovering mines, less uncertain than the divining rod, but extremely difficult and precarious, is that called *shoding*; that is, tracing them by loose stones, fragments, or *shodes*, which may have been separated or carried off to a considerable distance from the vein, and are found by chance in running waters, on the superficies of the ground, or a little under.—"When the tinners (says Mr Price) meet with a loose single stone of tin ore, either in a valley or in ploughing or hedging, though at 100 fathoms distance from the vein it came from, those who are accustomed to this work will not fail to find it out. They consider, that a metallic stone must originally have appertained to some vein, from which it was severed and cast at a distance by some violent means. The deluge, they suppose, moved most of the loose earthy coat of the globe, and in many places washed it off from the upper towards the lower grounds, with such a force, that most of the backs or lodes of veins which protruded themselves above the fast were hurried downwards with the common mass: whence the skill in this part of their business lies much in directing their measures according to the situation of the surface." Afterwards, however, our author complains that this art of *shoding*, as he calls it, is in a great measure lost.

The following account of a method of finding silver mines by Alonzo Barba seems to be similar to that of shoding just now mentioned. "The veins of metal (says he) are sometimes found by great stones above ground; and if the veins be covered, they hunt them out after this manner; viz. taking in their hands a sort of mattock, which has a steel point at one end to dig with, and a blunt head at the other wherewith to break stones, they go to the hollows of the mountains, where the current of rain water descends, or to some other part of the skirts of the mountains, and there observe what stones they meet with, breaking in pieces those that seem to have any metal in them; whereof they find many times both middling sort of stones and small ones also of metal. Then they consider the situation of that place, and whence these stones can tumble, which of necessity must be from higher ground, and follow the track of them up the hill as long as they can find any of them," &c.

"Another way (says Mr Price) of discovering lodes

is

Mine. is by working drifts across the *country*, as we call it, that is, from north to south, and *vice versa*. I tried the experiment in an adventure under my management, where I drove all open at grass about two feet in the shelf, very much like a level to convey water upon a mill wheel; by so doing I was sure of cutting all lodes in my way: and I did accordingly discover five courses, one of which has produced above 180 tons of copper ore, but the others were never wrought upon. This method of discovering lodes is equally cheap and certain; for 100 fathoms in shallow ground may be driven at 50s. expence."

In that kind of ground called by our author *feasible*, and which he explains by the phrase *tenderstanding*, he tells us, that "a very effectual, proving, and consequential way is, by driving an adit from the lowest ground, either north or south; whereby there is a certainty to cut all lodes at 20, 30, or 40 fathoms deep, if the level admits of it. In driving adits or levels across, north or south, to unwater mines already found, there are many fresh veins discovered, which frequently prove better than those they were driving to."

After the mine is found, the next thing to be considered is, whether it may be dug to advantage. In order to determine this, we are duly to weigh the nature of the place, and its situation, as to wood, water, carriage, healthiness, and the like; and compare the result with the richness of the ore, the charge of digging, stamping, washing, and smelting.

Particularly the form and situation of the spot should be well considered. A mine must either happen, 1. In a mountain; 2. In a hill; 3. In a valley; or, 4. In a flat. But mountains and hills are dug with much greater ease and convenience, chiefly because the drains and burrows, that is, the adits or avenues, may be here readily cut, both to drain the water and to form gangways for bringing out the lead, &c. In all the four cases, we are to look out for the veins which the rains or other accidental thing may have laid bare; and if such a vein be found, it may often be proper to open the mine at that place, especially if the vein prove tolerably large and rich; otherwise the most commodious place for situation is to be chosen for the purpose, viz. neither on a flat, nor on the tops of mountains, but on the sides. The best situation for a mine is a mountainous, woody, wholesome spot; of a safe easy ascent, and bordering on a navigable river. The places abounding with mines are generally healthy; as standing high, and everywhere exposed to the air; yet some places where mines are found prove poisonous, and can upon no account be dug, though ever so rich. The way of examining a suspected place of this kind, is to make experiments upon brutes, by exposing them to the effluvia or exhalations, to find the effects.

Devonshire and Cornwall, where there are a great many mines of copper and tin, is a very mountainous country, which gives an opportunity in many places to make adits or subterraneous drains to some valley at a distance, by which to carry off the water from the mine, which otherwise would drown them out from getting the ore. These adits are sometimes carried a mile or two, and dug at a vast expence, as from 2000l. to 4000l. especially where the ground is rocky; and yet they find this cheaper than to draw up the water out of the mine quite to the top, when the water runs in plenty, and the mine is deep. Sometimes, indeed, they cannot find a level near enough to which an adit may be carried from the very bottom of the mine; yet they find it worth while to make an adit at half the height to which the water is to be raised, thereby saving half the expence. Mine.

Mr Costar, considering that sometimes from small streams, and sometimes from little springs or collections of rain water, one might have a good deal of water above ground, though not a sufficient quantity to turn an overshot wheel, thought that if a sufficient fall might be had, this collection of water might be made useful in raising the water in a mine to the adit, where it may be carried off.

But now the most general method of draining mines is by the steam engine. See *Steam-Engine*.

Mine, in the military art, denotes a subterraneous canal or passage, dug under the wall or rampart of a fortification, intended to be blown up by gunpowder.

The alley or passage of a mine is commonly about four feet square; at the end of this is the chamber of the mine, which is a cavity of about five feet in width and in length, and about six feet in height; and here the gunpowder is stowed. The saucisse of the mine is the train, for which there is always a little aperture left.

Two ounces of powder have been found, by experiment, capable of raising two cubic feet of earth; consequently 200 ounces, that is, 12 pounds 8 ounces, will raise 200 cubic feet, which is only 16 feet short of a cubic toise, because 200 ounces, joined together, have proportionably a greater force than two ounces, as being an united force.

All the turnings a miner uses to carry on his mines, and through which he conducts the saucisse, should be well filled with earth and dung; and the masonry in proportion to the earth to be blown up, as 3 to 2. The entrance of the chamber of the mine ought to be firmly shut with thick planks, in the form of a St Andrew's cross, so that the enclosure be secure, and the void spaces shut up with dung or tempered earth. If a gallery be made below or on the side of the chamber, it must absolutely be filled up with the strongest masonry, half as long again as the height of the earth; for this gallery will not only burst, but likewise obstruct the effect of the mine. The powder should always be kept in sacks, which are opened when the mine is charged, and some of the powder strewed about: the greater the quantity of earth to be raised is, the greater is the effect of the mine, supposing it to have the due proportion of powder. Powder has the same effect upon masonry as upon earth, that is, it will proportionably raise either with the same velocity.

The branches which are carried into the solidity of walls do not exceed three feet in depth, and two feet six inches in width nearly: this sort of mine is most excellent to blow up the strongest walls.

The weight of a cubic foot of powder should be 80lb.; 1 foot 1 inch cube will weigh 100lb. and 1 foot 2 inches and $\frac{1}{12}$ 150lb.; and 200lb. of powder will be

Mine. be 1 foot 5 inches cube; however, there is a diversity in this, according to the quantity of saltpetre in the gunpowder.

If, when the mines are made, water be found at the bottom of the chamber, planks are laid there, on which the powder is placed either in sacks or barrels of 100lb. each. The saucisse must have a clear passage to the powder, and be laid in an auget or wooden trough, through all the branches. When the powder is placed in the chamber, the planks are laid to cover it, and others again across these; then one is placed over the top of the chamber, which is shaped for that purpose; between that and those which cover the powder, props are placed, which shore it up; some inclining towards the outside; others to the inside of the wall; all the void spaces being filled with earth, dung, brick, and rough stones. Afterwards planks are placed at the entrance of the chamber, with one across the top, whereon they buttress three strong props, whose other ends are likewise propped against another plank situated on the side of the earth in the branch; which props being well fixed between the planks with wedges, the branch should then be filled up to its entrance, with the forementioned materials. The saucisses which pass through the side branches must be exactly the same length with that in the middle, to which they join: the part which reaches beyond the entrance of the mine is that which conveys the fire to the other three; the saucisses being of equal length, will spring together.

From a great number of experiments, it appears, 1. That the force of a mine is always towards the weakest side; so that the disposition of the chamber of a mine does not at all contribute to determine this effect. 2. That the quantity of powder must be greater or less in proportion to the greater or less weight of the bodies to be raised, and to their greater or less cohesion; so that you are to allow for each cubic fathom

Of loose earth, - -	9 or 10lb.
Firm earth and strong sand,	11 or 12
Flat clayey earth, - -	15 or 16
New masonry, not strongly bound,	15 or 20
Old masonry, well bound, -	25 or 30

3. That the aperture, entonnoir of a mine, if rightly charged, is a cone, the diameter of whose base is double the height taken from the centre of the mine. 4. That when the mine has been overcharged, its entonnoir is nearly cylindrical, the diameter of the upper extreme not much exceeding that of the chamber. 5. That besides the shock of the powder against the bodies it takes up, it likewise crushes all the earth that borders upon it, both underneath and sidewise.

To charge a mine so as to have the most advantageous effect, the weight of the matter to be carried must be known; that is, the solidity of a right cone, whose base is double the height of the earth over the centre of the mine: thus, having found the solidity of the cone in cubic fathoms, multiply the number of fathoms by the number of pounds of powder necessary for raising the matter it contains, and if the cone contains matters of different weights, take a mean weight between them all, always having a regard to their degree of cohesion.

Mine ‖ Mineral.

As to the disposition of mines, there is but one general rule, which is, That the side towards which one would determine the effect be the weakest; but this varies according to occasions and circumstances.

The calculation of mines is generally built upon this hypothesis, That the entounoir of a mine is the frustum of an inverted cone, whose altitude is equal to the radius of the excavation of the mine, and the diameter of the whole lesser base is equal to the line of least resistance; and though these suppositions are not quite exact, yet the calculations of mines deduced from them have proved successful in practice; for which reason this calculation should be followed till a better and more simple be found out.

M. de Vallicre found that the entonnoir of a mine was a paraboloid, which is a solid generated by the rotation of a semiparabola about its axis; but as the difference between these two is very insignificant in practice, that of the frustum of a cone may be used.

MINEHEAD, a town of Somersetshire, 166 miles from London. It is an ancient borough, with a harbour in the Bristol channel, near Dunster castle, much frequented by passengers to and from Ireland. It was incorporated by Queen Elizabeth, with great privileges, on condition the corporation should keep the quay in repair; but its trade falling off, the quay was neglected, and they lost their privileges. A statute was obtained in the reign of King William, for recovering the port, and keeping it in repair, by which they were to have the profits of the quay and pier for 36 years, which have been computed at about 200l. a year; and they were at the expence of new-building the quay. In pursuance of another act, confirming the former; a new head has been built to the quay, the beach cleared, &c. so that the biggest ship may enter, and ride safe in the harbour. The town in 1811 contained 1037 inhabitants. It was formerly governed by a portreeve, and now by two constables chosen yearly at a court leet held by the lord of the manor. Its chief trade is with Ireland, from whence about 40 vessels used to come hither in a year with wool; and about 400 chaldrons of coals are yearly imported at this place, Watchet, and Poriock, from South Wales, which lies directly opposite to it about seven leagues over, the common breadth of this channel all the way from Holmes to the Land's End. Here are several rich merchants, who have some trade also to Virginia and the West Indies; and they correspond much with the merchants of Barnestaple and Bristol in their foreign commerce. Three or four thousand barrels of herrings, which come up the Severn in great shoals about Michaelmas, are caught, cured, and shipped off here every year, for the Mediterranean, &c. The market here is on Wednesday, and fair on Whitsun-Wednesday.

MINERAL, in *Natural History*, is used in general for all fossil bodies, whether simple or compound, dug out of a mine; from whence it takes its denomination. See MINERALOGY.

MINERAL Waters. All waters naturally impregnated with any heterogeneous matter which they have dissolved within the earth may be called *mineral waters*, in

Mineral. in the most general and extensive meaning of that name; in which are therefore comprehended almost all those that flow within or upon the surface of the earth, for almost all these contain some earthy or saline matter. But, strictly speaking, those waters only which hold in solution such a quantity of foreign ingredients as to give them properties which are easily recognised by the taste or smell come under the denomination of mineral waters. Mineral

For the methods of analyzing mineral waters, see CHEMISTRY *Index* in this work, and DECOMPOSITION CHEMICAL, SUPPLEMENT.

Here we shall give a tabular view of the more remarkable mineral waters which have been discovered and examined.

An ALPHABETICAL TABLE of the most noted Mineral Waters in Europe, exhibiting their Medicinal Properties and Contents.

Names of Springs.	*Countries in which they are found.*	*Contents and Quality of the Water.*	*Medicinal Virtues.*
Abcourt,	Near St Germains in France.	A cold chalybeate water, containing besides the iron a small quantity of fossil alkali saturated with fixed air.	Diuretic and purgative. Internally used in dropsies, jaundice, and obstructions of the viscera; externally in scorbutic eruptions, ulcers, &c.
Aberbrothick,	County of Forfar in Scotland.	A cold chalybeate. Contains iron dissolved in fixed air.	Diuretic and corroborative. Used in indigestions, nervous disorders, &c.
Acton,	Middlesex county, England.	Contains Epsom and sea salt. Cold.	Strongly purgative, and causes a soreness in the fundament.
Aghaloo,	Tyrone, Ireland.	Sulphur, fossil alkali, and some purging salt. Cold.	Alterative and corroborant. Useful in scrofulous disorders, worms, and cutaneous diseases.
Aix-la-Chapelle,	Juliers in Germany.	Sulphureous and hot. Contain aerated calcareous earth, sea salt, fossil alkali, and sulphur.	Diaphoretic, purgative, and diuretic. Used as baths as well as taken internally. Useful in rheumatisms, and all diseases proceeding from a debility of the system.
Alford or Awford,	Somersetshire, England.	A purging salt along with sea salt. Cold.	Strongly purgative.
Askeron,	Yorkshire, in England.	Contains Epsom salt, aerated calcareous earth, and sulphur. Cold.	Diuretic. Useful when drunk in leprosy, and other cutaneous diseases.
Antrim,	Ireland.		Similar to Borrowdale water, but weaker.
Baden,	Swabia in Germany.	Hot and sulphureous springs and baths, resembling those of Aix-la-Chapelle.	See AIX-LA-CHAPELLE, and BADEN, in the order of the Alphabet.
Bagnigge,	Middlesex, near London.	Epsom salt and muriated magnesia. Cold. Another spring contains iron and fixed air.	Strongly purgative, three half pints being a dose. The chalybeate spring also proves purgative when the bowels contain any vitiated matter.
Balimore,	Worcestershire in England.	A fine cold chalybeate, containing iron rendered soluble by fixed air, along with some other salt supposed to be fossil alkali.	Corroborative, and good in obstructions of the viscera. Drank from two to three pints in a morning.
Ball or Baudwell,	Lincolnshire in England.	A cold petrifying water; contains aerated calcareous earth or magnesia.	Corroborative and astringent. Drunk to the quantity of two pints, or two and a half.
Balarue,	Languedoc in France.	Hot, and contain some purging salts.	Drank as purgatives, and used as hot baths. Useful in scrofulous and cutaneous disorders.
Ballycastle,	Antrim in Ireland.	Chalybeate and sulphureous. Cold.	Resembles that of Balimore in virtue.
Ballynahinch,	Down in Ireland.	Iron, fixed air, and sulphur. Cold.	Useful in scorbutic disorders and diseases of indigestion.
Ballyspellan	Near Kilkenny in Ireland.	Iron, fixed air, and probably fossil alkali.	Similar in virtue to that of Balimore.

Names of Springs.	*Countries in which they are found.*	*Contents and Quality of the Water.*	*Medicinal Virtues.*
Bagneres,	Bigorre in France.	Earth and sulphur. Hot.	The waters used in baths, like those of Aix-la-Chapelle. Some of the springs purgative, others diuretic.
Bareges,	Bigorre in France.	Sea salt, fossil alkali, calcareous earth, selenites, sulphur, and a fine bituminous oil. Hot.	Diuretic and diaphoretic. Useful in nervous as well as cutaneous disorders, in old wounds and some venereal complaints. Used as baths, as well as taken internally to the quantity of a quart or three pints.
Barnet and North-hall,	Hertfordshire in England.	Epsom salt, and aerated calcareous earth.	Purgative.
Bath,	Somersetshire in England.	Iron, aerated calcareous earth, selenite, Glauber's salt, and sea salt. Hot.	Powerfully corroborative, and very useful in all kinds of weaknesses. Used as a bath, and taken internally.
Bandola,	Italy.	Iron, fixed air, fossil alkali, and a little sulphur.—Cold.	Gently laxative, diuretic, and diaphoretic.
Borrowdale,	Cumberland in England.	A great quantity of sea salt, aerated calcareous earth, and some bittern. Cold.	Strongly emetic and cathartic. Sometimes useful in the jaundice and dropsy, scorbutic disorders, and chronic obstructions. Used likewise as a bath in cutaneous diseases. Taken in the dose of a pint, containing only about seven drachms and a half of sea salt; so that a great part of the virtue must reside in the aerated calcareous earth.
Brentwood,	Essex in England.	Epsom salt, and aerated calcareous earth.	Purgative.
Bristol,	Somersetshire in England.	Calcareous earth, sea salt, Epsom salt, Glauber's salt, and selenites. Hot.	Used as a bath; and drank from four to eight ounces at a time, to two quarts per day. Useful in consumptions, diabetes, fluor albus, &c.
Bromley,	Kent in England.	Iron and fixed air. Cold.	Diuretic and corroborative.
Broughton,	Yorkshire in England.	Sulphur, sea salt, Epsom salt, and aerated earth. Cold.	Similar to Harrowgate.
Buxton,	Derbyshire in England.	A small quantity of sea salt, fossil alkali, Epsom salt, and aerated calcareous earth. Hot. Here is also a fine cold chalybeate spring.	Useful in gout, rheumatism, and other disorders in which tepid baths are serviceable. Used as baths, and drank to the quantity of five or six pints per day.
Caroline baths,	Bohemia.	Iron, fixed air, aerated earth, sea salt, fossil alkali, Epsom salt, and Glauber's salt. Hot.	Purgative, and used as baths. Of service in disorders of the stomach and bowels, scrofula, &c.
Carlton,	Nottinghamshire in England.	Iron dissolved in fixed air, along with a bituminous oil, which gives it the smell of horse dung.—Cold.	Diuretic and corroborative.
Carrickfergus,	Antrim in Ireland.	Seems from its bluish colour to contain a very small quantity of copper. Cold.	Weakly purgative.
Carrickmore,	Cavan in Ireland.	Fossil alkali, fixed air, and some purging salt. Cold.	Purgative and diuretic.
Cashmore,	Waterford in Ireland.	Green vitriol.	Purgative, diuretic, and sometimes emetic.
Castle-Connel,	Limerick in Ireland.	Iron dissolved in fixed air, &c. Cold.	Resembles the German Spaw, and is in considerable repute.
Castle-Leod,	Ross-shire in Scotland.	Aerated earth, selenites, Glauber's salt, and sulphur. Cold.	Diuretic, diaphoretic, and corroborant; useful in cutaneous diseases.

Names of Springs.	*Countries in which they are found.*	*Contents and Quality of the Water.*	*Medicinal Virtues.*
Castlemain,	Kerry in Ireland.	Iron, sulphur, and fixed air. Cold.	Corroborant and diuretic.
Cawley,	Derbyshire in England.	Epsom salt, aerated calcareous earth, and sulphur. Cold.	Gently purgative.
Cawthorp,	Lincolnshire in England.	Iron, fixed air, and probably fossil alkali. Cold.	Purgative, and corrects acidities.
Chadlington,	Oxfordshire in England.	Fossil alkali, sea salt, and sulphur. Cold.	Purgative.
Chaude Fontaine,	Liege in Germany.	Aerated earth, fossil alkali, and fixed air. Hot.	Resembles those of Aix-la-Chapelle and Buxton.
Cheltenham,	Gloucestershire in England.	Calcareous earth, iron, Epsom salt, and common salt. Cold.	Purgative and corroborant; taken in the quantity of from one to three or four pints. It is useful in cases of indigestion and scorbutic disorders; also in the gravel.
Chippenham,	Wiltshire in England.	Iron dissolved in fixed air.	Diuretic and corroborative.
Cleves,	Germany.	Iron, fixed air, and other ingredients of Pyrmont water.	Diuretic and corroborant.
Clifton,	Oxfordshire in England.	Fossil alkali and aerated calcareous earth or selenite. Cold.	Gently laxative, and used as a bath for cutaneous disorders.
Cobham,	Surry in England.	Iron, and some purging salt.	Purgative, diuretic, and corroborant.
Codsalwood,	Staffordshire in England.	Sulphur, fixed air, and acrated earth.	Resembles the Askeron water.
Colchester,	Essex in England.	Epsom salt, and aerated calcareous earth.	Strongly purgative.
Colurian,	Cornwall in England.	Iron, fixed air, and aerated earth.	Corroborative and diuretic.
Comner, or Cumner,	Berkshire in England.	Some purging salt, and probably aerated earth; the water is of a whitish colour.	Purgative, in the quantity of one, two, or three quarts.
Coolauran,	Fermanagh in Ireland.	Iron, fixed air, and acrated earth.	Diuretic.
Corstorphine,	Mid Lothian in Scotland.	Sulphur, sea salt, clay, and Epsom salt. Cold.	Diuretic and laxative.
Coventry,	Warwickshire in England.	Iron, fixed air, and some purging salt.	Purgative, diuretic, and corroborant.
Crickle Spaw,	Lancashire in England.	Sulphur, sea salt, and aerated earth.	Purgative, and resembling Harrowgate water.
Croft,	Yorkshire in England.	Aerated earth, vitriolated magnesia, and sea salt.	Purgative, and resembling Askeron water.
Crosstown,	Waterford in Ireland.	Martial vitriol.	Diuretic, purgative, and sometimes emetic.
Cunley-house,	Lancashire in England.	Sulphur, aerated earth, and fixed air.	Purgative, and resembling the Askeron water.
Das Wild Bad,	Nuremberg in Germany.	Iron, fixed air, and some saline matter.	Corroborant. Useful in obstructions of the viscera, and female complaints.
D'ax en Foix,	15 leagues from Thoulouse in France.	Similar to Aix-la-Chapelle. Hot.	Used as a bath, and also drunk, like the Aix-la-Chapelle waters.
Deddington,	Oxford in England.	Iron, sulphur, aerated earth, sea salt, or fossil alkali.	Alterative, purgative in large quantity, and useful in scorbutic and cutaneous disorders.
Derby,	Near the capital of Derbyshire in England.	Iron dissolved by fixed air.	Corroborant.
Derryinch,	Fermanagh in Ireland.	Sulphur and fossil alkali.	Diuretic and diaphoretic.
Derrindaff,	Cavan in Ireland.	Sulphur and purging salt.	Similar to the *Askeron* water.

Names of Springs.	*Countries in which they are found.*	*Contents and Quality of the Water.*	*Medicinal Virtues.*
Derrylester,	Cavan in Ireland.	Similar to *Swadlingbar* water.	
Dog and Duck,	St George's Fields, London.	Aerated magnesia, Epsom salt, and sea salt.	Cooling and purgative, but apt to bring on or increase the fluor albus in women.
Dortshill,	Staffordshire in England.	Iron dissolved in fixed air.	Corroborant.
Drigwell,	Cumberland in England.	Similar to Deddington.	
Dropping-well,	Yorkshire in England.	Aerated earth.	Astringent and corroborant.
Drumas-nave,	Leitrim in Ireland.	Sulphur, fossil alkali, with some purging salt.	Powerfully diuretic and anthelmintic, and of use in cutaneous and scrofulous disorders.
Drumgoon,	Fermanagh in Ireland.	Similar to the former.	
Dublin salt springs,	Ireland.	Sea salt and Epsom salt.	Purgative.
Dulwich,	Kent in England.	Sea salt and Epsom salt.	Purgative and diuretic. Useful in nervous cases and diseases proceeding from debility.
Dunnard,	18 miles from Dublin.	Iron dissolved in fixed air.	Diuretic and corroborant.
Dunse,	Scotland.	Iron dissolved in fixed air, with a little sea salt and bittern.	Similar to the former.
Durham,	England.	Sulphur, sea salt, and a little aerated earth. In the middle of the river is a salt spring.	Similar to the Harrowgate water.—That of the salt spring used as a purgative.
Egra,	Bohemia.	Similar to Cheltenham water.	
Epsom,	Surry in England.	Vitriolated and muriated magnesia, with a small quantity of aerated calcareous earth.	Purgative, and of use in washing old sores.
Fairburn,	Ross-shire in Scotland.	Sulphur, aerated earth, and Glauber's salts.	Alterative, and useful in cutaneous diseases.
Felstead,	Essex in England.	Similar to Islington.	
Filah,	Yorkshire in England.	Sea salt and aerated earth.	Powerfully diuretic and purgative.
Frankfort,	Germany.	Sulphur and sea salt.	Similar to Harrowgate.
Gainsborough,	Lincolnshire in England.	Sulphur, iron, aerated earth, and Epsom salt.	Diuretic and laxative.
Galway,	Ireland.	Similar to Tunbridge water.	
Glanmile,	Ireland.	Similar to Peterhead water.	
Glastonbury,	Somersetshire in England.	Similar to Clifton water.	
Glendy,	Merns county in Scotland.	Similar to Peterhead water.	
Granshaw,	Down in Ireland.	Iron; similar to the German Spaw.	
Haigh,	Lancashire in England.	Green vitriol, iron dissolved by fixed air, with some aerated earth.	Emetic and cathartic.
Hampstead,	England	Green vitriol, iron dissolved by fixed air, and a small quantity of aerated earth.	Alterative and corroborant. The water is taken from half a pint to several pints; is better in the morning than in the middle of the day, and in cold than hot weather.
Hanbridge,	Lancashire in England.	Similar to Scarborough water.	Less purgative than the Scarborough water.

Names of Springs.	*Countries in which they are found.*	*Contents and Quality of the Water.*	*Medicinal Virtues.*
Hanlys,	Shropshire in England.	Epsom, or other purging salt.	Purgative.
Harrowgate,	Yorkshire in England.	Sulphur, sea salt and some purging salt. Some chalybeate springs here also.	Alterative, purgative, and anthelmintic; useful in scurvy, scrofula, and cutaneous diseases. Used externally for strains and paralytic weaknesses.
Hartfell,	Annandale in Scotland.	Green vitriol, alum, and azotic gas.	Astringent and corroborant. Useful in all kinds of inward discharges of blood.
Hartlepool,	Durham in England.	Sulphur, iron dissolved by fixed air, with some purging salt.	Diuretic and laxative.
Holt,	Wiltshire in England.	Purging salt, with a large quantity of aerated earth.	Mildly purgative. Useful in old ulcers and cutaneous disorders.
Joseph's well,	Stock Common near Cobham in Surry.	A very large proportion of Epsom salt, and possibly a little sea salt.	Alterative, purgative, and diuretic. Drank to about a quart, it passes briskly without griping: taken in less doses as an alterative, it is a good antiscorbutic.
Ilmington,	Warwickshire in England.	Aerated fossil alkali, with some iron dissolved by fixed air.	Diuretic and laxative.
Inglewhite,	Lancashire in England.	Sulphur, and iron dissolved by fixed air.	Alterative. Useful in scorbutic and cutaneous diseases.
Islington,	Near London.	Iron dissolved by fixed air.	Corroborant. Useful in lowness of spirits and nervous diseases. Operates by urine, and may be drank in large quantity.
Kanturk,	Cork in Ireland.	Similar to the water at Peterhead.	
Kedlestone,	Derbyshire in England.	Sulphur, sea salt, and aerated earth.	Similar to Harrowgate; but intolerably fetid.
Kensington,	Near London.	Similar to Acton water.	
Kilbrew,	Meath in Ireland.	A large quantity of green vitriol.	Emetic and cathartic, in the dose of half a pint.
Kilburn,	Near London.	Fixed air, hepatic air, Epsom salt, Glauber's salt; muriated magnesia, sea salt, aerated earth, and iron.	
Killasher,	Fermanagh in Ireland.	Sulphur and fossil alkali.	Similar to Swadlingbar water.
Killingshanvally,	Fermanagh, Ireland.	Similar to Hanlys chalybeate water.	
Kilroot,	Antrim in Ireland.	Nature of Borrowdale water, but weaker.	
Kinalton,	Nottinghamshire in England.	A purging salt.	Purgative.
Kineardine,	Merns in Scotland.	Similar to the water of Peterhead.	
Kingscliff,	Northamptonshire in England.	Similar to Cheltenham waters.	
Kirby,	Westmoreland in England.	Iron, fixed air, and probably some fossil alkali.	Laxative, and useful in correcting acidities.
Knaresborough,	See *Dropping-well.*		
Knowsley,	Lancashire in England.	Similar to Scarborough water.	
Kuka,	Bohemia.	Aerated fixed alkali.	Operates by insensible perspiration, sometimes by spitting, sweat or urine.
Lancaster,	England.	Similar to Tunbridge water.	
Latham,	Lancashire in England.	Similar to the former.	

Names of Springs.	*Countries in which they are found.*	*Contents and Quality of the Water.*	*Medicinal Virtues.*
Llandrindod,	Radnor in South Wales.	Three springs; a purgative, a sulphureous, and chalybeate.	Useful in the scurvy, leprosy, cutaneous disorders, &c.
Llangybi,	Caernarvonshire in North Wales.		Useful in disorders of the eyes, scrofula, &c.
Leamington,	Warwickshire in England.	Sea salt and aerated calcareous earth.	Emetic and cathartic. Useful in old sores, and cures mangy dogs.
Leez,	Essex in England.	Similar to Islington water.	
Lincomb,	Somersetshire in England.	Aerated iron, fossil alkali, and a little Epsom salt.	
Lisbeak,	Fermanagh in Ireland.	Sulphur, &c.	Similar to Swadlingbar water.
Lis done-Vurna,	Clare in Ireland.	Fossil alkali, with much iron,	Emetic, cathartic, and diuretic.
Loansbury,	Yorkshire in England.	Sulphur, and some purging salt.	Used only for washing mangy dogs and scabby horses.
Maccroomp,	Cork in Ireland.	Similar to Ilmington water.	
Mahereberge,	Kerry in Ireland.	Similar to Borrowdale water.	
Mallow,	Cork in Ireland.	A hot water, similar to that of Bristol.	
Malton,	Yorkshire in England.	Iron and fixed air in considerable quantity.	Similar to Scarborough water, but is sometimes apt to vomit.
Malvern,	Gloucestershire in England.	Iron. Two springs.	Diuretic and cathartic; used also externally. Recommended as excellent in diseases of the skin; in leprosies, scorbutic complaints, scrofula, old sores, &c. Also serviceable in inflammations and other diseases of the eyes; in the gout and stone, in bilious and paralytic cases, and in female obstructions. The external use is by washing the part at the spout several times a-day, and afterwards covering it with cloths dipt in the water and kept constantly moist; also by general bathing.
Markshall,	Essex in England.	Similar to Islington.	
Matlock,	Derbyshire in England.	Warm springs, of the nature of the Bristol water, except that they are very slightly impregnated with iron, but contain a great quantity of aerated earth. They are colder than the Buxton; but their virtues similar to those of the two places mentioned.	
Maudsley,	Lancashire in England.	Sulphur and sea salt.	Similar to Harrowgate.
Mechan,	Fermanagh in Ireland.	Sulphur and fossil alkali.	Similar to the waters of Drumgoon.
Miller's Spaw,	Lancashire in England.	Similar to Tunbridge.	
Moffat,	Annandale in Scotland.	Sulphurated hydrogen, carbonic acid and azotic gases, with common salt.	Alterant, diuretic, and sometimes purgative. Is used as a bath, and the steam of the hot water has been found serviceable in relaxing hard tumors and stiff joints.
Moss-house,	Lancashire in England.	Similar to Islington water.	Purges strongly.
Moreton,	Shropshire in England.	Similar to Holt water.	

Names of Springs.	*Countries in which they are found.*	*Contents and Quality of the Water.*	*Medicinal Virtues.*
Mount D'Or,	France.	Warm, and similar to the waters of Aix-la-Chapelle.	Diuretic, purgative, and diaphoretic.
Nevil Holt,	Leicestershire in England.	Selenite or aerated earth, and Epsom salt.	Purgative, diuretic, and diaphoretic.—Powerfully antiseptic in putrid diseases, and excellent in diarrhœa, dysenteries, &c.
New Cartmall,	Lancashire in England.	Sea salt and aerated earth.	Purgative.
Newnham Regis,	Warwickshire in England.	Similar to Scarborough water.	
Newtondale,	Yorkshire in England.	Aerated calcareous earth or magnesia.	Astringent or tonic.
Newton-Stewart,	Tyrone in Ireland.	Similar to Tunbridge.	
Nezdenice,	Germany.	Fixed air, fossil alkali, iron, and earth.	Diuretic, diaphoretic, and tonic.
Nobber,	Meath in Ireland.	Martial vitriol.	Similar to Hartfell.
Normanby,	Yorkshire in England.	Sulphur, much fixed air, some sea salt, and Epsom salt.	Similar to Askeron water.
Nottington,	Dorsetshire, England.	Sulphur, fossil alkali, and earth.	Useful in cutaneous diseases.
Orston,	Nottingham, England.	Much fixed air, Epsom salt, and a little sea salt, with some iron.	Purgative.—It intoxicates by reason of the great quantity of air contained in it.
Oulton,	Norfolk, England.	Similar to Islington.	
Owen Breun,	Cavan, Ireland.	Sulphur, Epsom salt, and fossil alkali.	Similar to Askeron water.
Pancras,	Near London.	Epsom salt, and aerated earth.	Diuretic and purgative.
Passy,	Near Paris.	Similar to Pyrmont water.	
Peterhead,	Aberdeen county, Scotland.	A strong chalybeate, but of which no analysis has been published.	Similar to Islington, but more powerful.
Pettigoe,	Donnegal, Ireland.	Sulphur and purging salt.	Similar to Askeron water.
Pitkeathly,	Perthshire, Scotland.	Sea salt, a small quantity of muriated and likewise of aerated earth.	Gently purgative. Very useful in scrofulous and scorbutic habits.
Plombiers,	Lorraine, France.	Saline matter, probably fossile alkali, with a small portion of oil.—Warm.	Used as a bath, and for washing ulcers. Inwardly taken it cures complaints from acidity, hemorrhagies, &c.
Pontgibault,	Auvergne, France.	Fossil alkali and calcareous earth.	Diuretic and laxative.
Pougues,	Nivernois, France.	Calcareous earth, magnesia, fossil alkali, sea salt, earth of alum, and siliceous earth.	Diuretic and laxative.
Pyrmont,	Westphalia, Germany.	Aerated iron, calcareous earth, magnesia, Epsom salt, and common salt.	Diuretic, diaphoretic, and laxative. Recommended in cases where the constitution is relaxed; in female complaints, in cutaneous diseases, in nervous disorders, in the gravel and urinary obstructions; and considered as among the best restoratives in decayed and broken constitutions.
Queen Camel,	Somersetshire, England.	Sulphur, sea salt, fossil alkali, calcareous earth, and bituminous oil.	Used in scrofulous and cutaneous disorders.
Richmond,	Surry in England.	Similar to Aeton water.	
Rippon,	Yorkshire, England.	Sulphur, sea salt, and aerated earth.	Diaphoretic and alterant.

Names of Springs.	*Countries in which they are found.*	*Contents and Quality of the Water.*	*Medicinal Virtues.*
Road,	Wiltshire, England,	Sulphur, iron, fossil alkali, and fixed air.	Useful in scrofula, scurvy, and cutaneous disorders.—Acts as a laxative.
St Bartholomew's well,	Cork in Ireland.	Fossil alkali, iron, and fixed air.	Similar to Tilbury water.
St Bernard's well,	Near Edinburgh.	Similar to the waters of Moffat.	Somewhat congenial with Moffat and Harrowgate. In nervous and stomachic cases, analeptic and restorative; in scorbutic, scrofulous, and most dropsical cases, reckoned a specific.
St Erasmus's well,	Staffordshire, England.		Similar to Borrowdale water.
Scarborough,	Yorkshire, England.	Aerated calcareous earth, Epsom salt, sea salt, and iron.	Diuretic and purgative.
Scolliensis,	Switzerland.	Iron, fossil alkali, and a great quantity of fixed air.	Excellent in colic pains, both as a cure and preventive.
Seidlitz,	Bohemia.	Epsom salt.	Strongly purgative.
Seltzer,	Germany.	Calcareous earth, magnesia, fossil alkali, and fixed air.	Diuretic. Useful in the gravel, rheumatism, scurvy, scrofula, &c.
Sene, or Send,	Wiltshire, England.	Similar to Islington.	
Seydschutz,	Germany.	Similar to Seidlitz.	
Shadwell,	Near London.	Green vitriol.	Emetic and cathartic.
Shapmoor,	Westmoreland, England.	Sulphur and purging salt.	Similar to Askeron water.
Shettlewood,	Derbyshire, England.		Similar to Harrowgate water.
Shipton,	Yorkshire, England.	Sulphur, sea salt, and purging salt.	Similar to Harrowgate.
Somersham,	Huntingdonshire, England.	Green vitriol, alum, and fixed air.	Corroborant and alterative. Useful for washing foul ulcers and cancers.
Spaw,	Liege in Germany.	Fossil alkali, iron, acrated earth, Epsom salt, and sea salt.	Diuretic and purgative. Serviceable in many disorders. See the article SPAW.
Stanger,	Cumberland, England.	Green vitriol.	Emetic and cathartic.
Stenfield,	Lincolnshire, England.	Similar to Orston.	
Streatham,	Surry, England.	Aerated earth, Epsom salt, sea salt, and muriated magnesia.	Purgative.
Suchaloza,	Hungary.		Similar to Nezdenice.
Sutton bog,	Oxfordshire, England.	Sulphur, fossil alkali, and sea salt.	Alterative and laxative.
Swadlingbar,	Cavan in Ireland.	Sulphur, earth, sea salt, and fossil alkali.	Alterative and diaphoretic.
Swansey,	Glamorganshire in North Wales.	Green vitriol.	Similar to Shadwell.
Sydenham,	Kent in England.	Similar to Epsom, but weaker.	
Tarleton,	Lancashire in England.	Similar to Scarborough water.	
Tewksbury,	Gloucestershire in England.	Similar to Acton.	
Thetford,	Norfolk in England.	Fossil alkali, fixed air, and iron.	Purgative and diuretic.
Thoroton,	Nottinghamshire in England.	Similar to Orston.	
Thursk,	Yorkshire in England.	Similar to Scarborough.	
Tibshelf,	Derbyshire in England.	Iron dissolved in fixed air.	Similar to Spaw water.

Names of Springs.	*Countries in which they are found.*	*Contents and Quality of the Water.*	*Medicinal Virtues.*
Tilbury,	Essex in England.	Fossil alkali.	Diuretic and diaphoretic.
Tober Bony,	Near Dublin in Ireland.	Fossil alkali, earth, and bituminous oil.	Similar to Tilbury.
Tonstein,	Cologne in Germany.	Fossil alkali.	Similar to Seltzer, but more purgative.
Tralee,	Kerry in Ireland.	Similar to Castle Connel.	
Tunbridge,	Kent in England.	Iron, some sea salt, with a little selenites and calcareous earth.	An excellent chalybeate, useful in all diseases for which the Spaw is recommended.
Upminster,	Essex in England.	Sulphur, fossil alkali, and purging salt.	Purgative and diuretic.
Vahls,	Dauphiny in France.	Fossil alkali.	Diuretic and laxative.
Wardrew,	Northumberland.	Sulphur, earth, and sea salt.	Similar to Harrowgate water.
Weatherstack,	Westmoreland in England.	Iron, sea salt, and a small quantity of hepatic gas.	Purgative.
Wallenfrow,	Northamptonshire in England.	Similar to Islington water.	
West Ashton,	Wiltshire in England.	Similar to Islington.	
Westwood,	Derbyshire in England.	Green vitriol.	Similar to Shadwell. Used for washing ulcers of the legs.
Wexford,	Ireland.	Similar to Islington.	
Whiteacre,	Lancashire in England.	Aerated iron, and probably calcareous earth.	Somewhat astringent.
Wigglesworth,	Yorkshire in England.	Sulphur, earth, and common salt.	Emetic in the quantity of two quarts, and said to be cathartic in the quantity of three; a singular circumstance if true.
Wildungan,	Waldech in Germany.	Similar to the waters of Bath.	Useful in scorbutic and gouty diseases.
Windgate Spaw,	Northumberland.	Carbonate of iron, green vitriol, alum, common salt, calcareous earth.	Corroborant and diuretic; and useful in stomach complaints and scrofula.
Witham,	Essex in England.	Aerated iron, and common salt.	Diuretic, alterative, and corroborant.
Wirksworth,	Derbyshire in England.	Sulphur, purging salt, and aerated iron.	Useful in scrofulous and cutaneous diseases.
Zahorovice,	Germany.	Similar to Nezdenice water.	Much esteemed in scrofulous cases.

MINERALOGY.

1 Definition.

MINERALOGY is that branch of natural history which has for its object the description and discrimination of inorganized or mineral substances, as they are found in the earth or on its surface.

2 History.

The knowledge of some mineral bodies may be considered as coeval with the earliest ages of the world. The rudest and most barbarous nations could not be ignorant of some of the properties of the substances which were most familiar to their observation; and mankind have made little progress in civilization, when they are entirely unacquainted with the nature of those matters from which some of the metals are extracted.

Precious stones, it seems not at all improbable, first attracted the notice of mankind. The richness of colour, brilliancy, lustre, and durability of these bodies, could not fail to excite admiration, and make them be sought after as ornaments, even by the least civilized people, and in countries where they are most abundant. They were well known, it would appear from the sacred writings, among the Jews and Egyptians in the time of Moses. At this period, however, both the Jews and Egyptians had advanced far in refinement.

But this knowledge was too limited to be dignified with the name of *Mineralogy*. It wanted that comprehensive, connected, and scientific view which could entitle it to that denomination. And indeed it may be said to be only of modern date that the knowledge of minerals rose to the rank of science, and assumed any thing like a regular and connected form.

3 Writers on minerals.

Dioscorides and Theophrastus among the Greeks, and Pliny among the Romans, have, it is true, described a few mineral bodies; and Avicenna, an Arabian philosopher and physician, who flourished in the end of the 10th and beginning of the 11th century, arranged those objects into four great classes, viz. 1. Stony bodies. 2. Saline bodies. 3. Inflammable bodies; and, 4. Metals —an arrangement which, it is curious to remark, must be well founded; for it has been adopted, sometimes indeed with slight deviations, by almost all mineralogical

History. writers since that period. But still the knowledge of minerals was bounded by very narrow limits.

The variety and value of mineral productions in Germany have excited more attention to these studies, and have thus rendered this knowledge of more interest and importance than in any other country. To Germany indeed it must be acknowledged that mineralogy is indebted in a great measure for its origin, and for a very ample share of its progressive improvement. George Agricola, a native of Misnia, in which country he settled as a physician, lived during the first half of the 16th century. Being strongly attached by inclination to the study of minerals, he removed to Chemnitz in Hungary, where he might have an opportunity of prosecuting his favourite studies; and there, by the most unwearied application to mineralogy, and particularly to the various operations on the metals, he became the most celebrated metallurgist of his time. He is supposed to be the first German author who professedly wrote on mineral substances. The following titles chiefly comprehend the various heads into which his works on metallurgy and mineralogy are divided, *De Ortu et Causis Subterraneorum; De Natura eorum quæ affluunt ex Terra; De Natura Fossilium; de Medicatis Fontibus; De Subterraneis Animantibus; De Veteribus et Novis Metallis;* and *De Re Metallica.* His arrangement of minerals is into two great divisions. 1. Simple or Homogeneous Minerals; and, 2. Heterogeneous Minerals. The first, or simple minerals, includes four subdivisions, viz. 1. Terra; 2. Succus Concretus; 3. Lapis; 4. Metallum. The second great division, the heterogeneous minerals, comprehends two subdivisions, viz. 1. Compound minerals; 2. Mixed minerals.

4 Agricola.

Several writers on mineralogy appeared in the course of the 17th century; and about the beginning of the 18th Beecher proposed an arrangement of bodies on chemical principles, or according to their constituent parts. In the year 1736, Linnæus published a system of mineralogy, in which mineral bodies are divided into three classes, viz. 1. *Petræ;* 2. *Mineræ;* 3. *Fossilia.* These are subdivided into orders: the first containing three, *Vitrescentes, Calcareæ, Apyræ;* the second containing three, *Salia, Sulphurea, Mercurialia;* and the third also containing three, *Concreta, Petrifacta, Terræ.* Three years afterwards the system of Cramer appeared, according to which all mineral substances are arranged into seven classes, of which the following are the titles. 1. Metals; 2. Semimetals; 3. Salts; 4. Inflammable substances; 5. Stones; 6. Earths; and, 7. Waters. About 10 years after the first publication of the mineral system of Linnæus, Wallerius professor of mineralogy at Upsal, and his cotemporary, communicated to the world a more enlarged and improved arrangement of mineral bodies than any which had hitherto appeared. According to the system of Wallerius, all minerals are distributed into four classes, each of which is subdivided into four orders. The first class, *Terræ*, includes the orders *Macræ, Pingues, Minerales*, and *Arenaceæ;* to the second class, *Lapides*, belong the orders *Calcarei, Vitrescentes, Apyri, Saxa;* the third class, *Mineræ*, comprehends the orders *Salia, Sulphurea, Semimetalla* and *Metalla;* and the fourth, *Concreta*, is composed of the orders *Pori, Petrifacta, Figurata*, and *Calculi.*

5 Beecher.

6 Linnæus.

7 Wallerius.

Of the systematic writers on mineralogy from the time of Linnæus, which have now been mentioned, and of others which the limits of this historical sketch do not permit us to notice, it is to be observed, that by all of them, although the general arrangement of Avicenna was not followed, yet in the subordinate divisions his classes were adopted, and constituted some of their orders. The classes of Avicenna were not restored till the time of Cronstedt, a Swedish mineralogist, in whose system, which was published in the year 1758, they resumed the place which they formerly held. The system of Cronstedt is divided into four classes, *Terræ, Salia, Phlogistica*, and *Metalla.* The first class, *Terræ*, includes 9 orders, *Calcareæ, Siliceæ, Granatinæ, Argillaceæ, Micaceæ, Fluores, Asbestinæ, Zeolitieæ*, and *Magnesiæ.* To the second class, *Salia*, belong two orders, *Acida* and *Alkalina.* The third class, *Phlogistica*, consists only of one order; and the fourth class, *Metalla*, is composed of two orders, *Metalla perfecta* and *Semimetalla.* The system of Cronstedt, the most complete which had yet been offered to the world, and which, by comparing it with the systems accounted by some the most perfect of the present day, will be found not much different in its arrangement, continued to be read and studied for more than twenty years, and was translated into different languages. This arrangement is founded on chemical principles. The first class, for instance, is divided into nine orders already enumerated, and corresponding, as he supposed, to nine earths, of one of which the stones included in each order are chiefly composed. But as the improvements in chemical analysis led to greater accuracy of investigation, the earths which Cronstedt supposed to be simple were found to be compound. The number of simple or primitive earths was then diminished to five; and thus the number of genera, as they appeared in the *Sciagraphia Regni Mineralis* of Bergman, published in 1782, was also five. At that period five earths only were known. The same method of constructing the genera is still followed, so that the number of genera has increased in proportion to the number of earths which have been since discovered.

History.

8 Cronstedt.

9 Bergman.

In the year 1780, a translation of Cronstedt's mineral system appeared in Germany, accompanied with notes by Werner, the celebrated professor of mineralogy at Freyberg in Saxony. Six years before this time Werner had published a separate treatise on the classification of minerals, in which he exhibited his method of describing them by means of external characters. The notes on Cronstedt's system are to be considered as a farther illustration of this method, as well as a catalogue of minerals belonging to Pabst Von Ohain, which was drawn up by the same naturalist and published in 1791. In Germany the method of Werner, we believe, is almost exclusively adopted; and it is chiefly followed in most other countries, France excepted, where mineralogical knowledge is also greatly cultivated.

10 Werner.

Mr Kirwan first introduced the knowledge of this system into Britain, in his treatise on mineralogy published in 1784; and about ten years afterwards it was still farther elucidated by the same author in an improved and enlarged edition of that work. In preparing the latter edition, Mr Kirwan enjoyed the peculiar advantage of consulting one of the completest and best arranged collections of minerals which had yet been made in any country. This is the Leskean collection of minerals.

11 Kirwan.

12 Leskean collection of minerals.

History. of fossils, which Mr Kirwan pronounces to be the most perfect monument of mineralogical ability now extant. "That the possession of this cabinet, Mr Kirwan proceeds to state, should escape the vigilance of the most learned nations, and fall to the lot of Ireland, hitherto so inattentive to matters of this nature, was little to be expected. Through the active zeal, however, of two of its most enlightened patriots (A), and the influence secured to them by former services of the most essential nature, the sums requisite for its purchase, and for building a repository to receive it, were obtained *." This splendid and extensive collection, we are farther informed, was made by Leske, whose name it now bears, and who was one of the earliest and most eminent of the disciples of Werner. It was arranged between the years 1782 and 1787, according to the principles of Werner, and with his assistance. After the death of Mr Leske, a catalogue was drawn up by Karsten, another of Werner's disciples. This catalogue in its arrangement corresponds to the arrangement of the cabinet, which is divided into five parts.

* *Preface to Mineralogy*, p. ix.

The first part, which is denominated the *characteristic* part, consists of 580 specimens. These are intended for the illustration of the external characters, or the principles of the classification.

The second, which is the *systematic* or oryctognostic part, comprehends all simple minerals distributed according to their genera and species agreeable to the method then followed by Werner. This part contains 3268 specimens.

The third part, which is called the *geognostic* or *geological*, includes the substances found in the different kinds of rocks, as they are divided into *primitive*, *transition*, *stratiform*, *alluvial*, and *volcanic* mountains. This part of the collection is peculiarly rich in petrifactions; and the whole number of specimens which it contains extends to 1100.

The fourth part is intended to illustrate the mineralogy of every country on the globe, by exhibiting its mineral productions. The order of arrangement of this part is from America to Asia, Europe, and Africa. As there are many countries yet unexplored, it is the most imperfect division of the whole collection; and, indeed, as Mr Kirwan observes, it can only be completed by national opulence.

The fifth part is called the *economical* collection. It is formed of 474 specimens of minerals which are employed in arts and manufactures, as in architecture, sculpture, agriculture, jewellery, colouring, dyeing, clothing, pottery, glazing, enamelling, polishing of metals, furnace-building, medicine, metallurgy, &c. The whole cabinet consists of 7331 specimens.

Such is the valuable source from which Mr Kirwan derived the information detailed in his system of mineralogy. And here we are led to throw out a hint that the friends of this science could not more effectually promote its knowledge, and encourage its progress, than by establishing similar collections wherever it is taught and studied. But patriotism and power are unfortunately oftener directed to deeds of splendour and magnificence, than they are occupied in forming and accomplishing the humbler and more permanent plans of national utility. History.

But to resume our narrative of the history of mineralogy, we cannot help expressing our regret that Mr Kirwan has never found it convenient to revise and improve his system as he might have done, aided by the immense stock of mineralogical knowledge which has been accumulated since its first publication. This is the more to be regretted, because, notwithstanding the rapid progress of the science, and the great improvements which the system of Werner has received, no good or even tolerable account of it has yet appeared in the English language.

France, where many branches of natural history have long flourished, has contributed largely to the science of mineralogy. Even the period of war, which at first sight would appear to be extremely adverse to the tranquil pursuits of knowledge, has in this case proved peculiarly favourable to the study of mineralogy in that kingdom. The knowledge of minerals has not only been encouraged and promoted in France, by being forced to direct her attention to her own resources, while her intercourse with other countries from which she derived various commodities indispensably necessary for economical purposes was interrupted; but also by the subjugation to her overgrown power, of those parts of Europe where mineralogy has been most cultivated and improved, thus affording every facility of correspondence, and rendering accessible those mineral treasures which exhibit the best and fullest illustration of the science. The French government, indeed, whatever form it may have assumed, has invariably been impressed with the importance of mineralogy; and even during the horrors of revolution, has never failed to promote its progress, by forming and supporting extensive collections, and establishing able and enlightened teachers at the expence of the nation.

Of the works on mineralogy which have appeared in France, we shall only mention the treatises of Brochant, Hauy, and Brongniart. They are the sources from which the information in the following treatise is chiefly derived, and they may be recommended as the best guides to the study of this department of natural history. The system of Brochant is formed entirely on the principles of Werner's classification, and is undoubtedly the most perspicuous account of the system of the German mineralogist which has yet been published. The principles on which the elaborate and ingenious method of arrangement proposed by the celebrated Hauy have been already detailed. (See CRYSTALLIZATION). Here we shall only remark that the study of the regular forms of minerals with a view to methodical arrangement, was successfully prosecuted by Bergman and Romé de Lisle; but has been extended and carried to the highest degree of perfection by the sagacity, profound physical knowledge, and mathematical address of the Abbé Hauy. But although the mineral system of this

13 Brochant

14 Hauy

(A) The Right Honourable John Forster, late Speaker of the Irish House of Commons, and the Right Honourable W. B. Cunningham.

History. this distinguished philosopher be founded on characters the most certain and the most uniformly permanent, yet it may be doubted whether the previous knowledge necessary to understand it, and in some cases the difficulty of applying its principles in ascertaining some of the most essential characters, may not preclude this work from being so generally and practically useful as other systems. The scientific mineralogist, however, will always regard it as a monument of indefatigable industry and patient research which has rarely been equalled, and will derive from it the most material aid in his studies.

The system of Hauy consists of four classes. I. The first class consists of substances which are composed of an acid united to an earth or an alkali, and sometimes to both; and it contains three orders: 1. Earths combined with an acid; 2. Alkalies combined with an acid; and, 3. Earths and alkalies combined with an acid. II. This class includes only earthy substances, but sometimes combined with an alkali. It constitutes the siliceous genus of other systems. III. The third class comprehends combustible substances which are not metals. It is divided into two orders; the first containing simple, and the second compound combustibles. IV. The metals form the fourth class. It is divided into three orders, which are characterized by different degrees of oxidation. Besides these classes there are three appendices. The first contains those substances whose nature is not sufficiently known to have their places accurately assigned in the system. The second appendix includes aggregates of different mineral substances. It is divided into three orders. The first treats of primitive rocks; the second of secondary and tertiary rocks; and the third of breccias. The third appendix is devoted to the consideration of volcanic products. This is divided into six classes; but it is to be observed, that the volcanic products of this mineralogist comprehend, not only such substances as are universally allowed to have a volcanic origin, but also basalts, traps, and other minerals, the origin of which is still questioned. History.

15 Brongniart. The system of Brongniart takes a wider range than other systems, including substances which are not treated of by writers on mineralogy. It is divided into five classes. The first contains those substances, excluding the metals, which are combined with oxygen. It contains two orders; the first including air and water, and the second the acids. The second class, which treats of saline bodies, is divided into two orders: the first comprehends the alkaline salts, and the second the earthy salts. The third class, containing the stones, is divided into three orders: the first, hard stones; the second magnesian; and the third argillaceous. The fourth class contains the combustible substances, which are divided into two orders; first compound, and second, simple combustibles. The fifth class includes the metals, which are divided into two orders; first, the brittle, and second the ductile metals. The treatise of Brongniart, notwithstanding some peculiarities in the classification which are not quite familiar to us, will be found one of the most useful that has hitherto appeared, not only on account of the accuracy of the descriptions, which are divested of every kind of redundancy, but also on account of the interesting geological discussions which are introduced, as well as numerous and important practical details in metallurgy and other useful arts.

The following treatise will be divided into two parts. The first part will contain the classification and description of minerals; and the second part will be destined to the analysis of minerals and to metallurgy, or the method of extracting metals from their ores.

PART I. OF THE CLASSIFICATION OF MINERALS.

THE method to be followed in this treatise is nearly that of Werner, all the material parts of which we shall freely borrow from the work of Brochant already noticed, as the best on the subject which we have had an opportunity of consulting. We shall, however, occasionally avail ourselves of any useful information which may be derived from the mineralogy of Kirwan, Brongniart, and Hauy; and in particular we shall insert the essential characters of the species given by the latter.

The universal characters employed by Werner in the description of minerals are seven in number: 1. Colour; 2. Cohesion; 3. Unctuosity; 4. Coldness; 5. Weight; 6. Smell; 7. Taste. The table and the illustrations which follow are chiefly taken from Weaver's translation of Werner's treatise on that subject.

In the following table is exhibited the arrangement of the generic external characters of fossils.

Common

Common Generic External Characters.

I. The Colour.
II. The Cohesion of the particles, in relation to which Fossils are distinguished into

			Solid	and	Fluid.
			Solid	and Friable.	
			Particular generic characters of solid Fossils.	Particular generic characters of friable Fossils.	Particular generic characters of fluid fossils.
Characters for the Sight.	External Appearance.	The external Form.	The external Form.	The external Form.	
		The external Surface.			
		The external Lustre.			
	Appearance of the Fracture.	The internal Lustre.	The Lustre.	The Lustre.	
		The Fracture.	The appearance of the particles.		
		The form of the Fragments.			
	Appearance of the distinct Concretions.	The Form of the distinct Concretions.			
		The Surface of Separation.			
		The Lustre of Separation.			
	General Appearance.	The Transparency.			The Transparency.
		The Streak.			
		The Stain.	The Stain.		
Characters for the Touch.		The Hardness.			
		The Solidity.	The Friability.		The Fluidity.
		The Frangibility.			
		The Flexibility.			
		The Adhesion to the Tongue.			Wetting of the fingers.
Characters for the Hearing.	The Sound.	The Ringing.			
		The Creaking.			
		The Rustling.			

Remaining Common Generic External Characters.

Characters for the
- Touch.
  - III. The Unctuosity.
  - IV. The Coldness.
  - V. The Weight.
- Smell. VI. The Smell.
- Taste. VII. The Taste.

EXTERNAL CHARACTERS of Minerals arranged according to their respective generic characters, and illustrated by appropriate examples.

Common Generic External Characters.

I. THE COLOUR.

The most obvious of the external characters of minerals, is colour; it is also one of the most certain characters, and often serves as the principal distinguishing mark of many mineral substances. In deriving the characters of minerals from colour, three things are considered: 1. The several principal colours, with their varieties. 2. The shade of colour. 3. The tarnished colours.

I. Principal Colours.

The several principal colours are not derived from the division of the solar ray by means of the prism, but are such as are considered simple in common life. The principal colours are the eight following; viz. white, gray, black, blue, green, yellow, red, and brown.

A. WHITE is the first principal colour, and it includes the following eight varieties.

1. *Snow white*, as snow white quartz, white lead ore, Carrara marble.

2. *Reddish*

Classification.

2. *Reddish white*, as porcelain earth, reddish white quartz.

3. *Yellowish white*, as white amber, zeolite, chalk.

4. *Silver white*, as native silver, native bismuth, and arsenical pyrites.

5. *Grayish white*, as several kinds of gypsum, quartz, and foliated granular limestone.

6. *Greenish white*, as white amianthus, talc, and calcareous spar.

7. *Milk white*, as calcedony, opal, and milk white quartz.

8. *Tin white*, as native quicksilver, native antimony, and white cobalt ore.

B. GRAY is the second principal colour, and its varieties are the following.

1. *Lead gray*, as in common galena, compact galena, gray antimonial ore, and vitreous copper ore.

2. *Bluish gray*, as in bluish gray clay, bluish gray marble, and bluish gray limestone.

3. *Pearl gray*, as in quartz, calcedony, and porcelain jasper.

4. *Reddish gray*, as in granular limestone and feldspar.

5. *Smoke gray*, as in gray hornstone, and in dark gray flint.

6. *Greenish gray*, as in cat's eye, prehnite, and some varieties of argillaceous schistus.

7. *Yellowish gray*, as in yellowish gray calcedony, yellowish gray tripoli.

8. *Steel gray*, as in specular iron ore, gray copper ore, striated gray ore of manganese.

9. *Ash gray*, as in quartz, wacken, and some varieties of argillaceous schistus.

C. BLACK, which is the third principal colour, is divided into the six following varieties.

1. *Grayish black*, as in basalt, black limestone, and black flint.

2. *Brownish black*, as in black blende, tin-stone crystals, black cobalt ore, and bituminous shale.

3. *Dark black*, or *velvet black*, as in Iceland agate or obsidian, schorl, and jet.

4. *Iron black*, as in micaceous iron ore, magnetic iron stone, and sometimes in antimoniated silver ore.

5. *Greenish black*, as in pitchstone, hornblende, and serpentine.

6. *Bluish black*, as in aluminous shale, black cobalt ore, dull black lead ore.

D. BLUE is the fourth principal colour, including seven varieties.

1. *Indigo blue*, as in blue martial earth.

2. *Prussian blue*, as in the sapphire and blue rock salt.

3. *Azure blue*, as in lapis lazuli, and azure copper ore.

4. *Violet blue*, as in fluor spar, amethyst, and in rock salt.

5. *Lavender blue*, as in a variety of porcelain, jasper, and lithomarga.

6. *Smalt blue*, as in light azure copper ore, and blue martial earth.

7. *Sky blue*, as in light azure copper ore, blue native vitriol, and sky blue fluor spar.

E. GREEN is the fifth principal colour, of which there are the following varieties.

1. *Verdigrease green*, as in green copper ore, green fluor spar. Classification.

2. *Celadon green*, as in the Brasilian beryl, and in pure green earth.

3. *Mountain green*, as in actynolite, hornstone, and in most beryls.

4. *Emerald green*, as in fibrous malachite and fluor spar.

5. *Leek green*, as in actynolite, jade, and prasium.

6. *Apple green*, as in chrysolite, prehnite, and nickel ore.

7. *Grass green*, as in some varieties of chrysoprase and some green lead ores.

8. *Pistachio green*, as in chrysolite, iron shot green copper ore.

9. *Asparagus green*, as in chryso beryl, and some varietes of green lead ore.

10. *Olive green*, as in green lead ore, serpentine, pitchstone, and garnet.

11. *Blackish green*, as in dark green serpentine.

12. *Canary green*, as in green lead ore, micaceous uranitic ore, and green steatites.

F. YELLOW is the sixth of the principal colours. It includes 12 varieties, which are the following.

1. *Sulphur yellow*, as in native sulphur and some varieties of serpentine.

2. *Lemon yellow*, as in yellow orpiment, and some yellow lead ores.

3. *Gold yellow*, as in native gold.

4. *Bell metal yellow*, as in iron pyrites.

5. *Straw yellow*, as in calamine and bismuth ochre.

6. *Wine yellow*, as in Saxon topaz and yellow calcareous spar.

7. *Isabella yellow*, as in calamine and sparry iron ore.

8. *Ochre yellow*, as in iron ochre, yellow jasper, and calamine.

9. *Orange yellow*, as in red orpiment and red lead ore.

10. *Honey yellow*, as in amber fluor spar and calcedony.

11. *Wax yellow*, as in yellow lead ore, common opal, and calcedony.

12. *Brass yellow*, as in copper pyrites, and native gold.

G. RED is the seventh principal colour, and it includes the following 15 varieties.

1. *Morning* or *aurora red*, as in red lead ore, red orpiment.

2. *Hyacinth red*, as in the hyacinth, and a variety of brown blende.

3. *Brick red*, as in porcelain jasper.

4. *Scarlet red*, as in light red cinnabar.

5. *Copper red*, as in native copper.

6. *Blood red*, as in Bohemian garnet, and red carnelian.

7. *Carmine red*, as in red copper ore, and clear red cinnabar.

8. *Cochineal red*, as in cinnabar, sometimes jasper, and red quartz.

9. *Crimson red*, as in ruby, oriental garnet, and red cobalt ore.

10. *Columbine red*, as in precious garnet, and red cobalt ore.

11. *Flesh red*, as in feldspar, red gypsum, red quartz, and flesh red barytes.

12. *Rose*

Classification.

12. *Rose red*, as in red zeolite, rose red quartz, and ruby.

13. *Peach blossom red*, as in striated and earthy red cobalt ores.

14. *Cherry red*, as in red antimony ore and ruby.

15. *Brownish red*, as in red argillaceous iron stone, and red earthy iron stone.

H. BROWN is the eighth and last of the principal colours. It is divided into the eight following varieties.

1. *Reddish brown*, as in brown tin stone, and brown blende.

2. *Clove brown*, as in rock crystal, brown iron ore, and thumerstone.

3. *Hair brown*, as in wood tin ore from Cornwall.

4. *Yellowish brown*, as in brown iron ochre and jasper.

5. *Tombac brown*, or pinchbeck brown, as in brown mica.

6. *Wood brown*, as in bituminous wood, a variety of asbestus.

7. *Liver brown*, as in brown cobalt ore, and brown jasper.

8. *Blackish brown*, as in lowland argillaceous iron ore, mineral pitch, and bituminous wood.

II. *Shade or Intensity of Colour.*

Colours may be determined by the relation in which they stand to each other with regard to intensity or shade. Thus among the principal colours, there are some which are light, as white and yellow; and some which are dark, as blue and black; and besides, the varieties of the principal colours differ from each other in respect to shade. Thus among the blue colours, indigo blue is dark, azure blue clear, and sky blue light; and even the varieties may afford a diversity of shade, as, for instance, clear canary green, light canary green.

Here it ought to be remarked, that the peculiar shade of colour in a mineral is frequently owing to its greater or less transparency, the paleness being in proportion to the degree of transparency, and the darkness to the degree of opacity. The degree of lustre also in minerals produces great variety in the shade of colour.

In discriminating the shade or intensity of colour, four degrees have only in general been adopted. These are the following. 1. *Dark*. 2. *Clear*. 3. *Light*. 4. *Pale*.

1. *Dark*, as in Bohemian garnet, which is dark blood red.

2. *Clear*, as in green hornstone, which is clear mountain green.

3. *Light*, as in red carnelian, which is light blood red.

4. *Pale*, as in aquamarine, which is pale mountain green.

III. *Tarnished Colours.*

Tarnished colours afford peculiar characteristic marks of many minerals. By tarnishing, is meant a difference in the colour of the surface after exposure to the air from what the fresh fracture of the mineral exhibits.

Some minerals are always found tarnished in their natural position in the earth, as in common galena, gray ore of antimony and blende: some tarnish on every fresh fracture being made, as in native arsenic and copper pyrites; while others are tarnished in both cases, as in native arsenic, and purple copper ore. Classification.

The colours of tarnished minerals are divided into, 1. *Simple*, and 2. *Variegated*.

1. SIMPLE TARNISHED COLOURS afford five varieties.

a. Gray is the tarnished colour of white cobalt ore, and steel gray of brown hematites.

b. Black is the tarnished colour of native arsenic, brown hematites, and gray cobalt ore.

c. Brown is the tarnished colour of native silver, which is white.

d. Reddish, of native bismuth, the fresh fracture of which is silver white.

e. Yellowish, of white cobalt ore, and argentiferous arsenical pyrites.

2. VARIEGATED TARNISHED COLOURS include four varieties.

a. Pavonine tarnished, as in copper pyrites, purple copper ore and common pyrites.

b. Iridescent tarnished, as in gray antimonial ore, galena, specular iron ore.

c. Columbine tarnished, as in copper pyrites.

d. Steel-coloured tarnished, as in gray cobalt ore.

IV. *The Play of Colour.*

The play of colour in a mineral can only be observed in sunshine or in a strong light. By this is understood that property which some minerals possess of refracting from particular spots the different rays of light. This effect is produced by the peculiar association of the molecules of the mineral, and the various degrees of its transparency. Accidental causes, however, produce a similar effect, such as slight rifts, cracks, &c.

The play of colour is remarkable in the diamond and in the opal, and sometimes in rock crystal.

V. *The Mutable Reflection of Colour.*

This is distinguished from the play of colour by the mineral exhibiting in the same spot a change of colour according to the position of its surface being varied, producing a different angle with the incident rays of light. This change takes place, 1. *On the surface*; 2. *Internally*.

1. The *superficial* mutable reflection is finely exemplified in Labrador stone, and in a variety of marble which contains petrified shells.

2. The *internal* mutable reflection of colour appears in cat's eye, precious opal, and moonstone.

VI. *The Mutation of Colour.*

This is distinguished from the tarnish; in which latter the surface only undergoes a change of colour, but in the mutation of colour, the effect penetrates the mineral, and sometimes pervades the whole. This affords two varieties.

1. *The fading of colour.*—By this is meant that the colour of a mineral becomes paler when it is exposed to the light, heat, or is undergoing decomposition. Examples of these changes may be observed in striated red cobalt ore, which exposed to the air becomes pale brownish; blue fluor spar becomes green; chrysoprase becomes light green; pearl gray silver ore becomes clear brown.

2. *The perfect change of colour* is often the consequence of fading, when one colour is lost, and a new

co-

Classification. one appears, as in light-coloured sparry iron ore; earthy gray ore of manganese, and argillaceous iron stone.

VII. *Delineations of Colours.*

The delineations of colours are observed on simple minerals, the same specimen containing several colours, which pass through its interior, according to certain delineations. Of these delineations the following nine varieties are described.

1. *Dotted*, when fine points of another colour are dispersed over the surface, as in serpentine, and some varieties of jasper.

2. *Spotted*, when the points or spots are of the size of a lentil to that of a sixpence, or from one-fourth to one inch in diameter. The spots are round and regular, or irregular.

a. Regular, as in some varieties of serpentine, and in argillaceous schistus.

b. Irregular, as in a variety of marble from Bayreuth.

3. *Nebulous or cloudy*, when the spots are large and irregular, forming with the ground colour the appearance of clouds, as in calcedony and jasper.

4. *Flamy*, when the spots are large, and drawn in one direction to a sharp point, as in striped jasper and some marbles.

5. *Striped*, when large spots are drawn in the same direction, and run parallel through the whole specimen. There are two varieties.

a. Straight or curved striped, as in straight striped jasper.

b. Broad or linear, as in linear striped agate, calcedony, &c.

6. *Annular*, when the stripes form concentric circles, as in jasper, carnelian, and flints.

7. *Dendritic*, when the delineation resembles the trunk of a tree separating into ramifications, as in steatites, some limestones, Egyptian marble, and calcedony.

8. *Ruinous*, when the delineation presents the appearance of ruins, as in Florentine or landscape marble.

9. *Veined*, when the delineation consists of variously coloured narrow stripes, crossing each other in different directions, forming sometimes the appearance of a net, as in marble, serpentine, and jasper.

II. THE COHESION OF THE PARTICLES.

The cohesion of the particles in minerals is the second common generic character, which is observed by the sight, and also by the touch. According to this property, minerals are divided into solid, friable, and fluid; but these properties also belong to the particular generic characters of minerals, to be afterwards described.

Particular Generic External Characters of Solid Minerals.

1. The External Appearance.

In the external appearance of a mineral, three things are to be observed, the external form, the external surface, and the external lustre.

1. The external form of a mineral is that figure or shape of the natural surface, which its primitive individuals are found to possess. The external forms of solid minerals are distinguished into common, particular, regular or crystallized, and extraneous. Classification.

1. *Common External Shape.*

When a mineral exhibits no resemblance to any known substances in common life, it is said to be of a common form. Of common forms there are six kinds.

A. *Massive*, when a mineral is of an indeterminate form, or amorphous, and of nearly equal dimensions, from the size of a hazel nut to the greatest magnitude, and when it is incorporated with another solid mineral, it is said to be massive. Solid minerals are most frequently found of this external form, and some are never found otherwise, as in steatites, common pit-coal, galena, and copper pyrites.

B. *Disseminated*, or interspersed, when a mineral, without any particular form, is in small pieces not exceeding the size of a hazel nut, incorporated with another solid mineral. This affords three varieties.

a. Coarsely interspersed, in size of a hazel nut to that of a pea, as in copper pyrites.

b. Finely interspersed, from the size of a pea to that of a grain of millet, as in tinstone, in granular quartz.

c. Minutely interspersed, from the size of a grain of millet till it is scarcely perceptible to the eye, as in interspersed native gold.

C. In angular pieces, of which there are two varieties.

a. Sharp-cornered, as in calcedony and in quartz.

b. Blunt-cornered, as in common opal.

D. In grains. Detached minerals, from the size of a hazel nut to that which may be distinguished by the eye, are said to be in grains. These are distinguished,

a. According to size, into

α. In gross grains from the size of a hazel nut to that of a pea, as in lowland argillaceous iron ore.

β. Large grains, from the size of a pea to that of a hemp seed, as in precious garnet, magnetic iron sand.

γ. Small grains, from the size of hemp seed to that of millet, as in the above minerals.

δ. In minute or fine grains, such as are smaller than millet seeds, as platina, native gold, tinstone.

b. According to the form, which is in

α. Angular grains, as in magnetic iron sand.

β. Rounded grains, as in platina and native gold.

c. According as they inhere in other minerals. In this respect they are, *α.* Loose, *β.* Partially, or *γ.* Wholly.

E. In plates, distinguished into

a. Thick plates, as in red silver ore.

b. Thin plates, as in vitreous silver ore.

F. In membranes or flakes, when the thickness does not much exceed that of paper, divided into

a. Thick, as in native silver.

b. Thin, as in iron pyrites.

c. Very thin, as in vitreous silver ore.

2. *Particular External Forms.*

The forms which come under this denomination exhibit a greater or less resemblance, both to natural and artificial objects. They are called particular, because, like the former, they are not usual or common. There

Classification.

There are five kinds of particular external forms, viz. elongated, rounded, flattened, impressed, and confused.

A. ELONGATED. Of this there are eleven varieties.

a. Dentiform, as in native silver, and dentiform vitreous silver ore.

b. Filiform, as in native silver, and vitreous silver ore.

c. Capillary, resembling hairs, as in native gold and native silver.

d. Reticulated, as in native silver, native copper, and a variety of galena.

e. Dendritic, which is either regular or irregular, as in native silver and native copper.

f. Coralliform, as in calcareous stalactites, commonly known by the name of *flos ferri*, and brown hæmatites.

g. Stalactitiform, as in calcareous sinter, brown iron stone, and calcedony.

h. Tubuliform, as in compact brown iron stone, and galena.

i. Fistuliform, as in martial pyrites.

k. Frutescent, or *arbustiform*, as in black iron stone, and compact gray ore of manganese.

l. Matrasiform, having the figure of a chemical matrass, as in black hæmatites, and gray ore of manganese.

B. ROUNDED, of which there are five varieties.

a. Botryform, resembling a bunch of grapes, as in black cobalt ore, malachite, and copper pyrites.

b. Globular, of which there are five varieties.

α. Perfectly globular, as in pisolite, and white cobalt ore.

β. Elliptical, as in quartz and flint.

γ. Amygdaloid, as in zeolite and green earth.

δ. Spheroidal, as in Egyptian jasper and calcedony.

ε. Imperfectly globular, as in carnelian and calcedony.

c. Kidneyform, as in red hæmatites, native arsenic, and malachite.

d. Bulbous or *nodular*, as in nodular flint and martial pyrites.

e. Liquiform, as in a singular variety of galena, from Freyberg.

C. FLATTENED. Of the particular forms of this denomination there are three kinds.

a. Specular, as in compact galena, and compact red iron stone.

b. In *laminæ* or *leaves*, which form is peculiar to metals, as in native gold and silver.

c. Pectinated, as in quartz from Schemnitz.

D. IMPRESSED. Particular forms of these afford six varieties.

a. Cellular, of which there are several kinds, as,

α. Straight cellular, which presents two varieties. 1. Hexahedral, as in quartz; 2. Polyhedral, as in cellular quartz and calcareous spar.

β. Round cellular, as, 1. Parallel round, as in quartz; 2. Spongiform, as also in quartz; 3. Indeterminate, as in brown iron stone; 4. Double, as in quartz and hepatic pyrites; 5. Veiny, as in white cobalt ore.

b. With impressions, which are,

α. Cubical, as in quartz and fluor spar.

β. Pyramidal, as in quartz, fluor spar, and vitreous silver ore.

γ. Conical, as in native arsenic and quartz.

δ. Tabular or *prismatic*, as in quartz.

ε. Globular, as in vitreous silver ore.

c. Perforated, as in lowland argillaceous iron ore.

d. Corroded, as in quartz, galena, and vitreous silver ore.

e. Heteromorphous, as in native iron, swampy iron ore, and native arsenic.

f. Vesicular, as in lavas, pumice stones, basalt, and wacken.

E. CONFUSED, of which there is only one variety.

a. Ramose, as in native iron, sometimes native copper, and vitreous silver ore.

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3. *Regular External Forms* or *Crystallizations.*

In describing crystallizations or regular forms of minerals, four things are to be considered; the essential quality of the crystals; the form, aggregation, and magnitude.

A. THE ESSENTIAL QUALITY OF CRYSTALS, WHICH IS EITHER GENUINE OR SPURIOUS.

a. Genuine or *true crystals*, which are the most common, as in calcareous and fluor spars.

b. Spurious or *after crystals*, which are distinguished from true crystals by being hollow, having a rough or drusy surface, and the solid angles or edges never sharp or well defined. Examples are found in quartz of the spurious crystals of the cube, and of the octahedron of fluor spar.

B. FORM OF CRYSTALS. This is the most conspicuous property of crystals, and commonly serves as a distinctive character of those minerals which have regular forms. The form of crystals is composed of planes; of edges formed by the junction of two planes; of determinate angles, and of solid angles formed by the union of three or more planes in one point.

α. In the form of crystals, the primary or fundamental forms are first to be considered, and then the variations or modifications of these forms.

I. THE PARTS OF THE PRIMARY FORM ARE,

1. Planes, which are either

a. Lateral planes, forming the confines of the body towards its smallest extent; or, *b.* Extreme or terminal planes, which form the confines of the body towards its greatest extent.

2. Edges, which are,

a. Lateral edges, or, *b.* Extreme edges.

3. Solid angles, which have been defined above.

II. KINDS OF PRIMARY FORMS, which are the seven following.

1. *The Icosahedron*, which is composed of 20 equilateral triangular planes, united under equal angles, as in iron pyrites.

2. *The Dodecahedron*, which is composed of twelve regular, pentangular planes, united under equal obtuse angles, as in iron pyrites, and white cobalt ore.

3. *The Hexahedron*, including the cube and the rhomb, is composed of six quadrilateral planes, as in calcareous spar, fluor spar, iron pyrites, galena, &c.

4. *The Prism*, which is one of the most common crystallizations among minerals, is composed of an indeterminate number of quadrangular lateral planes, having the same direction, and all terminating in two extreme planes, each of which has as many sides as the crystallization possesses lateral planes; as in various lead ores, rock crystal, topaz, and shorl.

5. *The Pyramid* is composed of an indeterminate number of triangular lateral planes, converging to a

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point, and of a base having as many sides as the crystallization has lateral planes; as in quartz, calcareous spar, and amethyst.

6. *The Table*, which is composed of two parallel lateral planes, much larger in comparison than the other planes; the extreme planes being indeterminate in number, small, and narrow; as in tabular crystallized specular iron ore, calcareous spar, and heavy spar.

7. *The Lens*, consists of two lateral planes only, differing according as the lateral planes are differently curved. Of this there are two kinds: 1. The common lens, composed of two convex lateral planes; and, 2. The selliform, consisting of one convex and one lateral plane, somewhat resembling a saddle. Crystals of both kinds are observed in sparry iron ore and calcareous spar.

III. Differences in each kind of primary forms.

These primary forms differ from each other according to simplicity, position, number of planes, size of the planes, angles under which they meet, direction of the planes, and fulness of the crystal.

1. *Simplicity*. This distinction is confined to the pyramid, which is either,

A. *Simple*, as in light red silver ore, gray copper ore, quartz, amethyst; and

B. *Double*, in which those of the one pyramid are either,

a. Set on the lateral planes of the other, and this *α*. directly, or *β* obliquely; or *b*. on the lateral edges of the other. Examples of this are observed in double pyramidal vitreous silver ore, galena, rock crystal, ruby, and diamond.

2. *Position*, which is either,

A. *Erect*, which is very common; or, B. *Inverted*, which has only been observed in simple hexahedral pyramidal crystals of calcareous spar.

3. *Number of Planes*, in the primary form, is in some determinate, and in the others variable. Here are to be considered,

A. The kind of planes, as

a. In the prism and pyramid, in which the lateral planes vary; and, *b*. In the table, in which the extreme planes vary.

B. The number of planes, which in the prism and pyramid are found,

a. *Trihedral*, having three planes, as in the trihedral prism of shorl, and the trihedral pyramid of gray copper ore.

b. *Tetrahedral*, having four planes, as in the tetrahedral prism of arsenical pyrites, and in the double tetrahedral pyramid of ruby and galena.

c. *Hexahedral*, as in the hexahedral prism and pyramid of calcareous spar.

d. *Octahedral*, as in the octahedral prism of topaz; and in the double octahedral pyramid of garnet and zeolite.

The table occurs,

a. *Quadragonal*, having four extreme planes, as in heavy spar, yellow lead ore, and calamine.

b. *Hexagonal*, having six extreme planes, as in mica and heavy spar.

c. *Octagonal*, or with eight extreme planes, as in yellow lead ore and heavy spar.

4. *The size of the planes*, in relation to each other, which are said to be, Classification.

A. Equal, or

B. Unequal; and this latter is either indeterminate, or determinate.

a. *Indeterminate*, which is observed in the lateral planes of the hexahedral prism of rock crystal.

b. *Determinately unequal*, as in prismatic white lead ore, and hexahedral prismatic calcareous spar. In this latter the following varieties are observed.

α. Alternately broad and narrow. *β*. The two opposite broader; and, *γ*. The two opposite narrower.

5. *Angles under which the planes are associated.* These are angles of the lateral edges, of the extreme edges, and of the summit.

A. *Angles of the lateral edges.* These are,

a. *Equiangular*, as in the icosahedral crystals of iron pyrites.

b. *Rectangular*, as in cubical fluor spar.

c. *Oblique angular*, as in rhomboidal calcareous spar.

d. *Unequiangular*, as in the hexahedral prism of rock crystal, and in the octahedral prism of topaz.

A. Angles of the extreme edges are,

a. *Equiangular*, as in the hexagonal table of mica.

b. *Rectangular*, as in the quadragonal table of heavy spar.

c. *Oblique angular*, which is either, *α*. Parallel, as in the tetrahedral prism of feldspar; or, *β*. Alternate oblique angular, as in copper pyrites.

d. *Unequiangular*, as in the hexagonal table of prehnite.

C. Angles of the summit, which are confined to the pyramid, and present the following varieties.

a. *Very obtuse*, when the angle is from 150° to 130°, as in tourmalin.

b. *Obtuse*, when the angle is from 130° to 110°, as in calcareous spar.

c. *Rather obtuse*, from 110° to 90°, as in honey stone.

d. *Rectangular*, as in zircon.

e. *Rather acute*, from 90°, to 70°, as in quartz.

f. *Acute*, from 70° to 50°, as in calcareous spar.

g. *Very acute*, from 50° to 30°, as in sapphire.

6. *The direction of the lateral planes.* These are either straight or curvated.

A. *Straight planes* are even surfaces, and are the most common.

B. *Curvated planes* are distinguished according to position and form.

a. *Position*, which is, *α*. Inwardly curvated or concave; or, *β*. Outwardly curvated or convex; and, *γ*. Inwardly and outwardly curvated, or concave and convex. The first is observed in fluor spar, the second in diamond, and the third in sparry iron stone.

b. *The form* is either, *α*. Spherical, as in brown spar; *β*. Cylindrical, in which the curvature runs, 1. Parallel to the sides, as in iron pyrites, or, 2. Parallel to the diagonal, as in fluor spar; and, *γ*. Conical, as in gypsum.

7. *The fulness of the crystal.* Crystals are either full and perfect, or hollowed at the extremity, or throughout.

A. Full or perfect crystals, which is most commonly the case.

B. Hollowed

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B. Hollowed at the extremity, as in calcareous spar, green lead ore, &c.

C. Hollow through the whole crystal, as in prismatic beryl.

β. Modifications of the primary form.

The changes or alterations which take place on the principal or fundamental form, are three; truncation, bevelling, and acumination.

I. TRUNCATION. In the truncation are to be considered the parts and the determination.

1. The parts of the truncation are the planes, the edges, and the angles.

2. The determination of the truncation relates to,

a. The situation as it occurs at the angles or edges of the primary form.

b. Its magnitude, which, in relation to the planes of the primary form, is small or large: in the one case the angles or edges are said to be slightly, in the other deeply truncated.

c. The application of the truncation, which is either direct or oblique. The edges of cubical iron pyrites afford an example of oblique truncation.

d. The direction of the truncation, which presents either an even or a curvated surface.

Cubical galena, with truncated angles; tetrahedral prismatic tin stone crystals, with truncated edges; double tetrahedral pyramidal tin stone crystals, with truncated edges, are instances of truncation.

II. BEVELLING, in which the parts and determination are also to be considered.

1. The parts of the bevelling are, the planes, the edges, and the angles. The bevelling edges are distinguished into the proper bevelling edge, which is formed by the conjunction of the bevelling planes, and the bevelling edges formed by the junction of the bevelling planes with the lateral planes of the primary form.

2. The determination of the bevelling, in which is to be observed,

A. Its situation as it takes place, *a.* At the extreme planes, which is confined to the prism and table; *b.* At the edges, which is met with in the hexahedron, prism, pyramid, and table: and, *c.* At the angles, which is a very rare occurrence.

B. Its magnitude, which is said to be slight or deep.

C. The angle under which the bevelling planes conjoin, which is said to be, *a*, Acutely, *b.* Rectangularly, or, *c.* Obtusely bevelled.

D. The continuation of the bevelling, which is either uninterrupted, or interrupted. Of the latter case there are two varieties, when it is once or twice interrupted. The lateral edges of double tribedral pyramidal calcareous spar are once interruptedly bevelled; and the obtuse extreme edges of quadrangular tabular heavy spar, are twice interruptedly bevelled.

E, The application, *a.* Of the bevelling itself, which is either direct or oblique (the former is the most common, and the latter occurs in prismatic basaltic hornblende); and, *b.* Of the bevelling planes, which are set, either on the lateral planes, or on the lateral edges.

III. THE ACUMINATION, in which are also to be considered the parts of the acumination and the determination.

1. The parts of the acumination consist of,

A. The acuminating planes. B. The acuminating edges; which are distinguished into, *a.* Proper edges of acumination, formed by the junction of the acuminating planes; *b.* The extreme edges of acumination; *c.* The edges between the acuminating and lateral planes. C. The angles of acumination.

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2. The determination of the acumination relating to,

A. Its situation, as it occurs at *a.* The solid angles; or, *b.* At the extreme planes of the primary form. The acumination of the prism is always at the extreme planes; of the cube usually at the angles, and of the pyramid generally at the summit.

B. The planes themselves, in which are to be observed,

a. Their number, which is either equal to, or fewer than those of the primary form. In the hexahedral prism of calcareous spar and garnet, and in the tribedral prism of tourmaline, the acumination is by three planes; in the tetrahedral prism of jargon and hyacinth, by four planes; in the hexahedral prism of calcareous spar and rock crystal, by six planes; and in tetrahedral prismatic topaz, by eight planes.

b. Their relative size, which is either equal or unequal. In quartz and rock crystal, the planes of acumination are generally indeterminately unequal; and in heavy spar they are determinately equal.

c. Their form, which is determinate, as in hyacinth and calcareous spar; or indeterminate, as in jargon and wolfram.

d. Their application, which is either on the lateral planes of the primary form, as in jargon and hyacinth, or on the lateral edges, as in calcareous spar and garnet.

C. The summit of the acumination, which is, *a.* Obtuse, as in hexahedral prismatic garnet; *b.* Rectangular, as in tetrahedral prismatic jargon; or, *c.* Acute, as in hexahedral prismatic calcareous spar.

D. The magnitude of the acumination, which is said to be, *a.* Slightly acuminated, as in gray copper ore and copper pyrites; or, *b.* Deeply, as in fluor spar, with the angles acuminated by 6 planes.

E. Determination of the acumination; which is either a point or a line. The first is the most common; and the last is met with in prismatic white lead ore and heavy spar.

γ. Manifold modifications of the primary form.

In these modifications crystals are either, 1. Situated beside each other; or, 2. Placed the one above the other.

But in describing a crystallization, the number of its planes in general, and of each kind in particular, and their figure, if determinate, may be noticed, to render the description more accurate. As, for instance, cubical galena, with truncated angles, consist of 6 octangular and 4 triangular planes.

And still farther, in explaining the form of crystallizations, by way of addition may be mentioned,

1. The different modes of determination of which they are capable. Two different modes may in some cases be adopted.

a. The representative, by which is understood the description of a crystallization according to its apparent form; or,

b. The derivative, which is founded on the consideration of its derivation, and its relation to the other crystals of the same mineral. The prismatic crystallization of the tourmaline is representatively an enneahe-

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dral prism, and derivatively a trihedral prism, with the three lateral sides bevelled.

But, in general, the chief or essential form of a crystallization is determined by, *a.* The largest planes; *b.* The greatest regularity; *c.* The most frequent occurrence of the crystallizations; *d.* The affinity to the other primary forms; *e.* The suitableness and peculiarity of its modifications; and, *f.* The greatest simplicity in the mode of determination.

2. The transitions from one primary form into another. These arise,

a. From the gradually increased extent of the modifying planes, and the decreased extent of the primary planes; or,

b. From a change in the relative size of the planes; or,

c. From a change in the angles under which the planes are associated; or,

d. From the convexity of the planes; or,

e. From the aggregation of crystals.

3. The difficulties which are opposed to the exact determination of crystals. These proceed, *a.* From their compression, some planes being uncommonly large or small; or, *b.* From their penetrating each other, as in tin-stone crystals; or, *c.* From their partial concealment, as in feldspar, hornblende, and garnet; or, *d.* From their being broken, as often happens in the crystallization of precious stones; or, *e.* From their extreme minuteness.

C. The aggregation of crystals. According to this, crystals are either,

a. Single, in which case they are, *α.* Loose or detached, as in precious stones, cubical iron pyrites, &c.; *β.* Inhering or inlaying in another mineral, as feldspar in porphyry; or, *γ.* Adhering, as in quartz crystals; or,

b. Aggregated, which are either regular or irregular.

α. Regular or determinate; such are, 1. Twin crystals, as in staurolite or cross stone; and, 2. Triple crystals, as in calcareous spar and ruby: but this is very rare.

β. Many singly aggregated crystals, are such crystals as are, 1. Heaped upon one another, as in calcareous and fluor spars; 2. Adhering laterally, as in amethyst crystals; and, 3. Implicated one in the other, as in gray antimonial ore, and in the hexahedral prisms of calcareous spar.

γ. Many doubly aggregated crystals are distributed according to the form they assume; such as the following, are enumerated.

1. *Scopiform*, when aggregated, needle-like, and capilliform crystals diverge from a common centre, as in zeolite, striated red cobalt ore, and capilliform pyrites.

2. *Fasciform*, which is composed of double scopiform, with a common centre, as in calcareous spar, zeolite, and prehnite.

3. *Acicular* or *columnar*. Elongated, equally thick prisms adhering laterally together, are of this description, as in acicular heavy spar, and a variety of white lead ore.

4. *In a row*, like a string of pearls, as in pyramidal crystals of quartz.

5. *Bud-like*, in simple pyramids whose bases are connected, and whose joints are directed towards each other, as in bud-like drusen of quartz.

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6. *Globular*, a casual aggregation, consisting mostly of tables or cubes, arranged in a globular form, as in octahedral iron pyrites.

7. *Amygdaloid*, when the tables are externally accumulated, smaller upon smaller, as in heavy spar.

8. *Pyramidal*, which takes place chiefly in prisms nearly parallel, the summits inclining to each other; the central prism being the highest, as in calcareous spar.

9. *Rose-like*, composed of thin tables, on whose lateral planes others are assembled, and arranged in a rose-like appearance.

D. The magnitude of crystals, which is determined,

a. According to the greatest dimension, as *α.* Of an uncommon size, in crystals which exceed two feet, as in quartz and rock crystal; *β.* Very large, from two feet to six inches, as in rock crystal and calcareous spar; *γ.* Large, from six to two inches, as in iron pyrites, fluor spar, and garnet; *δ.* Of a middling size, from two inches to half an inch, which are very common; *ε.* Small, from half an inch to one-eighth of an inch, also very common; *ζ.* Very small, from one-eighth of an inch to such as may be distinguished by the naked eye, as in corneous silver ore, and very small tin stone crystals; *η.* Minute, whose form cannot be distinguished by the naked eye, as in native gold and green lead ore.

b. According to relative dimensions, when compared with others; and this is distinguished into *α.* Short or low, and long or high; *β.* Broad and narrow, or longated; *γ.* Thick and thin, or slender; *δ.* Needle-like and capilliform; *ε.* Spicular, and *ζ.* Globular or tessular.

4. Extraneous external forms, or petrifactions, which are divided into petrifactions of animals, and petrifactions of vegetables.

A. Petrifactions of animals, or zoolites, as

a. Of the class mammalia, the parts of which commonly found are the bones, the teeth, horns, and skeletons. Such are the bones of the elephant and the rhinoceros, which are found in Siberia, and the bones of the mammoth from North America.

b. Of birds, petrifactions of which are very rare. Some skeletons of aquatic birds have been met with in limestone near Oening.

c. Of amphibious animals, such as those of the tortoise, found in the same vicinity as the bones of the elephant; of frogs and toads, in the swine stone of Oening; and of an animal resembling a crocodile in aluminous shale near Whitby in Yorkshire.

d. Of fishes, of which whole fishes, skeletons, and impressions, have been found in different places.

e. Of insects, petrifactions of which are not very common, excepting insects, such as crabs, which have been frequently observed.

f. Of vermes, of which numerous petrifactions are found belonging to the orders *testacea*, *crustacea*, and *corallina* or corals.

B. Petrifactions of vegetables, which are less numerous in the mineral kingdom than those of animals. These are distinguished into,

a. Petrified wood, the most usual of which are petrifactions of the trunk, branches, or roots of trees, and commonly

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commonly consisting of siliceous substances, as wood-stone, jasper, horn stone.

b. Impressions of leaves and plants, which are not uncommon in the strata of coal countries, particularly in the shale, sand stone, the argillaceous iron stone, and the coal itself.

II. THE EXTERNAL SURFACE, which is the second particular generic character of solid minerals; and this is,

1. *Uneven*, having irregular elevations and depressions, as in calcedony.

2. *Granular*, when the elevations are small, round, and nearly equal, as in stalactitical brown hæmatites.

3. *Drusy*, having minute, prominent, equal crystals on the surface, as in iron pyrites and quartz crystals.

4. *Rough*, when the elevations are minute and almost imperceptible, as in cellular quartz.

5. *Scaly*, when the surface is composed of slender splinters like scales, as in chrysolite.

6. *Smooth*, as in hæmatites and fluor spar.

7. *Streaked*, which is either singly or doubly streaked.

A. Singly streaked surfaces are,

a. Transversely, as in rock crystals; *b.* Longitudinally, as in topaz and prismatic shorl; *c.* Diagonally, as in specular iron ore; and *d.* Alternately, as in iron pyrites.

B. Doubly streaked, which is,

a. Plumiformly, or like a feather, as in native silver and native bismuth; and,

b. Retiformly, as in gray cobalt ore.

8. *Rugose*. Of slight linear elevations, as in calcedony.

III. THE EXTERNAL LUSTRE, in which are to be determined,

1. The intensity of the lustre, which is distinguished into different degrees, as

A. *Resplendent*, which is the strongest kind of lustre, as in native quicksilver, galena, and rock crystal.

B. *Shining*, as in gray copper ore, heavy spar, and pitch-stone.

C. *Weakly shining*, as in iron pyrites, fibrous gypsum, and garnet.

D. *Glimmering*, as in earthy talc, in the fracture of flint, and of steatites.

E. *Dull*, as in most friable minerals, as in earthy lead ore, mountain-cork, chalk, &c.

2. The kind of lustre, which is either common or metallic.

A. The common lustre belongs chiefly to earthy stones and salts. It is distinguished into

a. Glassy, as in quartz and rock crystal.

b. Waxy or *greasy*, as in opal, and in yellow and green lead ores.

c. Pearly, as in zeolite.

d. Diamond, as in white lead ore and diamond.

e. Semimetallic, as in mica and hæmatites.

B. Metallic lustre, which is peculiar to metals and most of their ores, as native gold and native silver, copper pyrites, and galena.

Appearance of the fracture.

Here, as in the external appearance, three kinds of characters present themselves; I. The internal lustre; II. The fracture; III. The form of the fragment. Classification.

I. *The internal lustre*, the characters of which are to be determined in the same manner as the external lustre.

II. The *fracture*, which is either compact or jointed.

1. The compact fracture, which is distinguished into splintery, conchoidal, uneven, earthy, and hackly.

A. *Splintery*, which is either

a. Coarse splintery, as in quartz, prase, and jade; or

b. Fine splintery, as in hornstone and fine splintery limestone.

B. *Even*, which happens in minerals that are usually opake, and have only a glimmering lustre, as in compact galena, calcedony, and yellow carnelian.

C. *Conchoidal*, which is distinguished,

a. According to the size, into large and small.

b. According to the appearance, into perfect and imperfect; and

c. According to the depth, into deep and flat.

Flint, opal, jasper, and obsidian, afford examples of the conchoidal fracture.

D. *Uneven*, which is either,

a. Of a coarse grain, as in copper pyrites.

b. Of a small grain, as in gray copper ore, and

c. Of a fine grain, as in arsenical pyrites.

E. *Earthy*, which is the common fracture in earths and stones, as in marl, chalk, limestone.

F. *Hackly*, in which the fracture exhibits sharp points, which is peculiar to the metals, as in native gold and native copper.

2. The jointed fracture. This is divided into the fibrous, striated, foliated, and slaty.

A. The fibrous fracture, in which are to be observed,

a. The thickness of the fibres, as they are coarse, fine, or delicate, as gypsum, fine fibrous malachite, and in wood-tin-ore.

b. The direction of the fibres, which are straight, as in red hæmatites, and gray antimonial ore; or curved, as in black hæmatites, and fibrous rock salt.

c. The position of the fibres, which is α. Parallel, as in rock salt and amianthus: β. Diverging, which is, 1. Stelliform, as in black hæmatites, and fibrous zeolite; or, 2. Scopiform, as in fibrous malachite: or γ. Promiscuous, as in gray antimonial ore.

d. The length of the fibres, which is α. Long, as in gypsum and amianthus; or β. Short, as in red hæmatites.

B. Striated, in which are to be considered,

a. The breadth of the striæ, which are, α. Narrow, as in azure copper ore; β. Broad, as in actynolite and hornblende; or γ. Very broad, as in sapphire and zeolite.

b. The direction of the striæ, which is either, α. Straight, as in gray ore of manganese; or, β. Curved, as in zeolite and actynolite.

c. The position of the striæ, which is α. Parallel, as in asbestus and hornblende; β. Diverging, which is distinguished into stelliform, as in iron pyrites and zeolite, or scopiform, as in actynolite and limestone; or γ. Promiscuous, as in gray antimonial ore and actynolite.

d. Length of the striæ, as being α. Long striated, as in asbestus and gray antimonial ore; or β. Short striated, as in actynolite.

C. The

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C. *The foliated fracture*, in which are to be determined,

a. The magnitude of the folia, as being *α*. Large foliated, as in mica and specular gypsum. *β*. Scaly foliated, which is distinguished into 1. Coarse, 2. Small, and 3. Fine scaly foliated, as in micaceous iron ore and gypsum. *γ*. Granularly foliated, which is distinguished into 1. Gross, 2. Coarse, 3. Small, and 4. Fine granularly foliated, as in sparry iron ore, blende, and calcareous spar.

b. The perfectness of the folia, as being *α*. Perfectly foliated, as in feldspar; *β*. Imperfectly foliated, as in topaz; or, *γ*. Concealed foliated, as in emerald.

c. The direction of the folia, which is *α*. Straight, as in large foliated blende; or *β*. Curved foliated. The latter is distinguished into 1. Spherically curved, as in heavy spar; 2. Undularly curved, as in talc; 3. Petaloidally curved, as in galena; or, 4. Indeterminately curved, as in mica and specular gypsum.

d. The passage or cleavage of the folia, which is,

α. According to the angle which one passage forms with another; and this is either, 1. Rectangular, or, 2. oblique angular; or,

β. According to the number of the cleavages, and is either,

1. A single cleavage, as in mica and talc; 2. A double cleavage, as in feldspar and hornblende; 3. A triple cleavage, as in calcareous spar and sparry iron ore; 4. A quadruple cleavage, as in fluor spar; 5. A sextuple cleavage, as in yellow, brown, and black blende.

D. The slaty fracture, in which are to be determined the thickness and direction of the lamellæ.

a. The thickness of the lamellæ, which is either, *α*. Thick, or *β*. Thin slaty.

b. The direction of the lamellæ, as being either, *α*. Straight, or *β*. Curved slaty; the latter being distinguished into 1. Undularly, or 2. Indeterminately curved.

In some minerals which possess distinct parts, two kinds of fracture may be observed. Thus, in fibrous gypsum, and in red and brown hæmatites, both the fibrous and foliated fracture appear; the fibres are then intersected by the folia under a certain angle. In topaz, the transverse fracture is foliated, and the longitudinal fracture is conchoidal.

III. The form of the fragments, which is either regular or irregular.

1. Regular fragments, as when they are,

A. Cubical, as in galena and rock salt.

B. Rhomboidal, in which case the fragments are

a. Specular on all the planes, as in heavy spar;

b. On four planes, as in feldspar and hornblende; and,

c. On two planes, as in specular gypsum.

C. Trapezoidal fragments, &c.

D. Trihedral pyramidal fragments are rarely to be seen distinctly, excepting in fluor spar.

D. Dodecahedral fragments, as in blende.

2. Irregular fragments, as when they are,

a. Cuneiform, as in wood-tin-ore, and malachite.

B. Specular, as in amianthus.

C. Tabular, as in mica and talc.

D. Indeterminate, which are the most common among solid minerals, and are distinguished into

a. Very sharp edged, as in obsidian, common opal, and rock crystal.

b. Sharp edged, as in hornstone and quartz.

c. Moderately sharp edged, as in limestone.

d. Rather blunt edged, as in steatites; and

e. Blunt edged, as in chalk and fullers earth.

Classification.

3. The appearance of the distinct concretions.

In determining this character, the form of the distinct concretions, the surface of separation, and the lustre of separation, are to be considered.

I. The form of the distinct concretions, which is either granular, lamellar, columnar, or pyramidal.

1. Granular, distinct concretions are distinguished,

A. With respect to the form, into

a. Round granular, which is either *α*. Spherically round, as in roe stone and pisolite; or *β*. Lenticularly granular, as in argillaceous iron stone; or *γ*. Elongated round granular, as in quartz: and,

b. Angularly granular, which is either *α*. Common, as in galena and calcareous spar; or *β*. Elongated annularly granular, as in hornblende and granular limestone.

B. With regard to the size of the concretions. These are,

a. Gross granular, as in zeolite and blende.

b. Coarse granular, as in mica, galena, and pisolite.

c. Small granular, as in roe stone and garnet; and

d. Fine granular distinct concretions, as in granular limestone and galena.

2. Lamellar distinct concretions. The differences to be observed here are, with respect to the direction or form, and the thickness.

A. With respect to the direction or form, they are either,

a. Straight lamellar: and again either quite straight, as in some galena and heavy spar; or fortification-like, as in some amethyst and calcedony.

b. Curved lamellar, which is either indeterminate, as in galena and specular iron ore; reniform, as in fibrous malachite and native arsenic; or concentric, which is either spherical concentric, as in calcedony and pisolite, or conically concentric, as in some stalactites and hæmatites.

B. With regard to the thickness, as being

a. Very thick, the concretions exceeding one-half inch, as in amethyst and heavy spar.

b. Thick, the concretions being between one-half and one-fourth inch, as in heavy spar and native arsenic.

c. Thin, between one-fourth and one-half inch, as in calcedony.

d. Very thin, from a line to a thickness just perceptible to the naked eye, as in specular iron.

3. Columnar distinct concretions, which are distinguished with regard to the direction, thickness, form, and position.

A. The direction, which is either,

a. Straight columnar, as in schorl and calcareous spar, and,

b. Curved columnar, as in argillaceous iron stone, and specular iron ore.

B. The thickness is distinguished into,

a. Very thick, when the diameter exceeds two inches, as in basalt and quartz.

b. Thick

Classification.

b. Thick columnar, from two inches to one-fourth inch, as in amethyst and calcareous spar.

c. Thin, from one-fourth to one-half inch, as in calcareous spar and argillaceous iron stone.

d. Very thin, the thickness being less than a line, as in schorl and columnar argillaceous iron stone.

C. The form of the concretions being either

a. Perfectly columnar, as in argillaceous iron stone.

b. Imperfectly, as in amethyst.

c. Cuneiform columnar, as in calcareous spar and arsenical pyrites.

D. The position of the concretions, which is either

a. Parallel columnar, as in schorlite, or

b. Diverging or promiscuous columnar, as in schorl and arsenical pyrites.

4. Pyramidal distinct concretions. This form of concretion is very rare, and has been observed only in the basalt of Iceland, Faro, and Bohemia.

II. The surface of separation, which is distinguished into

1. Smooth, as in wood tin ore.

2. Rough, as in native arsenic.

3. Uneven, as in galena and blende; and

4. Streaked, which is either,

A. Longitudinally streaked, as in schorl and schorlite.

B. Transversely and fortification-like, as in amethyst and specular iron ore.

III. The lustre of separation. This character is to be determined in the same manner as the external lustre.

4. *The General Appearance.*

This comprehends three particular generic characters, the transparency, the streak, and the stain.

1. The transparency, which is distinguished into the following five degrees.

1. Transparent, which is either,

A. Common, as when objects appear single through a transparent mineral; or,

B. Doubling, when objects appear double, as in calcareous spar, or double refracting spar, jargon, and chrysolite.

2. Semitransparent, as in opal and calcedony.

3. Translucent, as in flint, cat's eye, and fluor spar.

4. Translucent at the edges, as in hornstone and foliated gypsum.

5. Opake, which is peculiar to minerals of a metallic lustre, as in malachite and jasper.

II. The streak, which is either,

1. Of the same colour, or,

2. Different from that of the mineral, and whose lustre is the same; or,

B. More or less different.

In red silver ore the streak is a dark crimson red; in cinnabar, scarlet red; in green lead ore, greenish-white; in red lead ore, clear lemon yellow.

III. The stain. With respect to this character, minerals are distinguished into such as,

1. Simply stain, and this either strongly or weakly, as gray ore of manganese, and red scaly iron ore; and into such as

2. Both stain and mark, as chalk and plumbago; and

3. Such as do not stain.

Characters for the Touch.

Characters of this description are, hardness, solidity, frangibility, flexibility, and adhesion to the tongue. Classification.

I. The *hardness*, which is determined by the following degrees.

1. Hard, as when a mineral gives fire with steel, but cannot be scraped with the knife. This character is distinguished into,

A. Hard, when the file makes a considerable impression, as in feldspar and schorl.

B. Very hard, on which it makes a weak impression, as in rock crystal and topaz.

C. Extremely hard, on which the file makes no impression, as diamond and emery.

2. Semihard may be slightly scraped with a knife, but gives no fire with steel, as red copper ore, blende, limestone.

3. Soft, easily scraped with the knife, as in galena, mica, asbestus.

4. Very soft, which receives an impression from the nail, as in gypsum, chalk, talc.

II. The *solidity*, according to which solid minerals are distinguished into,

1. Brittle, when the particles are in the highest degree coherent and immoveable, as in quartz, gray copper ore, and copper pyrites.

2. Sectile, when the particles are coherent but not perfectly immoveable among one another, as in plumbago and galena.

3. Malleable, when the integrant particles are coherent and also more or less moveable among one another, as in the most of the native metals.

III. The *frangibility*, with regard to which solid minerals are either,

1. Very difficultly frangible, as native metals, and massive common hornblende.

2. Difficultly frangible, as in prase, massive quartz, and asbestus.

3. Rather easily frangible, as iron pyrites, vitreous copper ore.

4. Easily frangible, as in galena, opal, and heavy spar.

5. Very easily frangible, as in amber and pitcoal.

IV. The *flexibility*, according to which solid minerals are,

1. Flexible, which is distinguished into,

A. Common, as in malleable minerals, amianthus, gold ore.

B. Elastic, as in mica, elastic mineral pitch from Derbyshire.

2. Inflexible, such minerals as break when the direction of the fibres is changed.

V. The *adhesion to the tongue*, according to which some minerals possess this property

1. Strongly, as in hydrophane.

2. Rather strongly, as in bole and lithomarga.

3. Weakly, as talc.

4. Very weakly, as in clay.

5. No adhesion at all, as is the case with most minerals.

Characters for the Hearing.

I. The sound, which is distinguished into

1. Ringing or sounding, as in native arsenic and common slate.

2. Creaking, as in native amalgam when pressed with the finger.

3. Rustling.

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3. Rustling, as in passing the finger over mountain cork and farinaceous zeolite.

2. Particular generic characters of friable minerals.

The characters included under this title are the external form, the lustre, the appearance of the particles, the stain and the friability.

I. The external form, which is either *massive*, as in porcelain earth; *interspersed*, as in black silver ore; as a *thick or thin crust*, as in black copper ore; *spumiform*, as in red and brown scaly iron ores; *dendritic*, as gray ore of manganese; or *reniform*, as pure clay and earthy talc.

II. The lustre, which is determined as in solid minerals; but here it is distinguished,

1. With regard to intensity, as

A. Glimmering, as in earthy talc and scaly iron ore; and,

B. Dull, as in earthy lead ore and lithomarga.

2. With regard to the kind, as it is *common* or *metallic*.

III. The appearance of the particles, which is either,

1. Dusty, as in black copper ore, iron ochres.

2. Scaly, as in earthy talc.

IV. The stain is distinguished in friable minerals as being either

1. Strong, as in scaly iron ore.

2. Weak, as in earthy lead ores.

V. The friability, with regard to which friable minerals are either,

1. Pulverulent, as earthy lead ores, and blue martial earth.

2. Loosely coherent, as scaly iron ore and clays.

3. Particular generic characters of fluid minerals. These characters relate to the external form, the lustre, the transparency, the fluidity, and the wetting of the fingers.

I. The external form, which is either,

1. In globules; and, 2. Liquiform; both which characters belong to native mercury.

II. The lustre, which is determined as formerly explained, and is either, 1. Common; or, 2. Metallic, as in native mercury.

III. The transparency, of which three degrees are distinguished in fluid minerals: 1. Transparent, as in naphtha; 2. Turbid, as in petroleum; 3. Opake, as in native mercury.

IV. The fluidity, which is characterised by being, 1. Perfectly fluid, as mercury, and, 2. Cohesive, as in mineral tar.

V. The wetting of the fingers. 1. Some fluid minerals wet the fingers, as mineral tar; and, 2. Some do not, as native mercury.

Remaining Common Generic External Characters.

The remaining common generic characters are the unctuosity; the coldness; the weight; the smell; and the taste.

III. The unctuosity, of which there are four degrees.

1. Meagre, as is the case with most minerals.

2. Rather greasy, as pipe clay.

3. Greasy, as fullers earth and steatites.

4. Very greasy, as talk and plumbago.

IV. The coldness, which includes three degrees.

1. Cold, having the coldness of quartz, as hornstone, jasper, marble.

2. Rather cold, as serpentine, gypsum,

3. Slightly cold, as amber, pitcoal, and chalk.

Classification.

By this character cut and polished stones may be distinguished, where some of the other characters are lost; and by it also natural gems may be distinguished from those which are artificial.

V. The weight.—This character is most accurately discovered by taking the specific gravity of a mineral by means of a hydrostatic balance. See HYDRODYNAMICS. But when this cannot be had recourse to, a mineral is examined by lifting it in the hand, and comparing its weight, thus estimated by the feeling, with its volume, by which means an approximation may be made to its specific gravity. Five degrees of this mode of estimating the weight of minerals have been assumed.

1. Supernatant, such minerals as swim in water, as naphtha, mountain cork.

2. Light, such minerals as have a specific gravity between 1.000 and 2.000, (taking water at 1.000) as amber, mineral pitch, and pitcoal.

3. Rather heavy, are such minerals as have a specific gravity between 2.000 and 4.000, which is the case with most kinds of stones, as amianthus, rock crystal, mica, fluor spar, diamond.

4. Heavy, when the specific gravity is from 4.000 to 6.000, as in most metallic ores, such as gray copper ore, red hæmatites, white lead ore, and in some others as heavy spar.

5. Extremely heavy, when the specific gravity exceeds 6.000, which includes the native metals, as native gold, native copper, and native silver, and some others, as galena, tinstone crystals, sulphurated bismuth, and vitreous silver ore.

VI. The smell is characteristic of only a small number of minerals. It is observed either,

1. Of itself without addition, and is,

A. Bituminous, as mineral pitch and naphtha.

B. Slightly sulphureous, as in native sulphur and gray antimonial ore.

C. Bitterish, as in ochre kept close shut up for some time.

D. Claycy, as in yellow chalk.

2. After breathing on a mineral, which should be cold and breathed upon strongly and quickly, when the smell perceived is,

A. Clayey bitter, as in hornblende and some sienites.

3. After rubbing or striking, when the smell emitted is,

A. Urinous, as in swinestone after rubbing.

B. Sulphureous, as in pyrites.

C. Garlic, as in arsenical pyrites and white cobalt ore.

D. Empyreumatic, as in quartz and pitcoal.

VII. The taste, which is characteristic of one class of minerals, only, viz. the salts; and it is either,

1. Sweetish saline, as rock salt.

2. Sweetish astringent, as native alum.

3. Sourish astringent, as native vitriol.

4. Bitter saline, as native Epsom salt.

5. Cooling saline, as native nitre.

6. Lixivious, as native alkali.

7. Urinous, as native sal ammoniac.

Beside the characters which we have now illustrated, some others are occasionally and successfully employed in the description of minerals. These have been brought under

Classification.

under the denomination of physical, chemical, and empirical characters.

1. *Physical.* The most common of the physical characters is the property which some minerals possess of exhibiting signs of electricity and magnetism. Some minerals become electric by being heated, and others by friction; and the electricity thus excited is in some vitreous or positive, and in others resinous or negative. Some minerals, too, and particularly some varieties of iron ore, are distinguished by being attracted by the magnet. Such are magnetic pyrites, and magnetic iron sand. By filing a mineral so fine that the particles shall swim on water, and then applying a magnet, the slightest degree of magnetic effect may be observed. Among the physical properties of minerals also, may be reckoned the phosphorescence, which is produced by friction, as in some varieties of blende; or by exposure to heat, as fluor spar, and some calcareous spars. To these characters also belongs the peculiar property of Lemnian earth and some other boles, which being thrown into water split into pieces with a crackling noise; and the property of some opals and other stones, of acquiring a higher degree of transparency when they are immersed in water, hence called hydrophanes.

2. *Chemical characters.*—By some simple experiments, the nature of many mineral substances may be easily and quickly ascertained, and particularly by means of acids. Thus, the nitrous acid is employed to discover whether a mineral effervesces, from which character the nature of the mineral can be more certainly known than by any other. Ammonia, or the volatile alkali, dissolves copper, and assumes a blue colour. Acetic acid is successfully employed as a test of lead, which communicates to the acid a sweetish taste. By means of heat, and particularly by the use of the blowpipe, much knowledge may be obtained of the nature of minerals. Some are volatilized; in others the colour is changed; and while some are nearly fused at different temperatures, others burn with a flame of peculiar colours.

3. *Empirical characters.*—Among these characters, the most common is the peculiar efflorescence which takes place in some ores. In copper ores the efflorescence is green or blue; in iron ores, brown, yellow, or red; in cobalt, peach blossom red; and in arsenic, white.

Characters for the distinction of minerals may be obtained from the circumstance of certain minerals being found generally accompanying others; as native arsenic with orpiment; gray copper ore with copper pyrites, and gray silver ore; red copper ore with native copper: white cobalt ore is rarely found without nickel; and by attending to this circumstance, it will not be mistaken for arsenical pyrites. Classification

For the sake of brevity, Mr Kirwan, and others after him, have adopted a method of expressing some of the characters by means of numbers. The following table exhibits some of these characters and corresponding numbers.

Resplendent, denoted by the number	4.
Shining	3.
Weakly shining	2.
Glimmering	1.
Dull	0.

Fragments, when the form is indeterminate.

Very sharp-edged	4.
Sharp-edged	3.
Rather sharp-edged	2.
Rather blunt	1.
Perfectly blunt	0.

Transparency.

Transparent	4.
Semitransparent	3.
Translucent	2.
Translucent at the edges	1.
Opake	0.

Hardness.

Of chalk, denoted by	3.
Yielding to the nail	4.
May be scraped with a knife	5.
Yields more difficultly to the knife	6.
Scarcely yields to the knife	7.
Does not give fire with steel	8.
Gives feeble sparks with steel	9.
Gives lively sparks	10.

But it is obvious that this abridged mode of expressing these characters, by means of numbers, can only be advantageously employed by those who have made themselves quite familiar with the different numbers corresponding to the different shades of character, and who can thus recollect them with facility and precision. To others this method of description, by requiring constant reference to the explanation, may prove rather embarrassing, so that what is gained in brevity may be lost in perspicuity. We propose, therefore, still to retain the verbal mode of expression in preference to the numerical.

Table of Minerals arranged in the order of their Genera and Species, each Genus being divided into Families or Groupes, the characters of which latter are derived from their external properties according to the method of Werner.

First Class.

EARTHS & STONES.

I. Diamond Genus.
Diamond.

II. Zircon Genus.
Zircon.
Hyacinth.

III. Siliceous Genus.

Chrysolite Family.
Chrysoberyl.
Chrysolite.
Olivine.
Coccolite.
Augite.
Vesuvian.

Garnet Family.
Leucite.
Melanite.
Garnet.
a. Precious.
b. Common.
c. Bohemian or Pyrope.
Grenatite or Staurolite.

Ruby Family.
Ceylanite.
Spinelle.
Sapphire.
Corundum.
Adamantine spar.
Emery.

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Schorl Family.
Topaz.
Pyrophysalite.
Euclase.
Emerald.
Beryl.
Schorlite.
Schorl.
a. Common.
b. Electric or Tourmaline.
Pistazite.
Zoisite.
Axinite or Thumerstone.
Quartz Family.
Quartz.
a. Amethyst.
Common.
Fibrous.
b. Rock crystal.
c. Rose-coloured or milk quartz.
d. Common quartz.
e. Prase.
f. Ferruginous quartz, or iron flint.
Hornstone.
a. Splintery.
b. Conchoidal.
c. Ligniform.
Flinty slate.
a. Common.
b. Lydian stone.
Flint.
Calcedony.
a. Common.
b. Carnelian.
Opal.
a. Precious.
b. Common.
d. Ligniform.
Menilite.
Jasper.
a. Egyptian.
b. Ribband.
c. Porcelain.
d. Common.
e. Agate.
f. Opal.
Heliotrope or Bloodstone.
Chrysoprase.
Plasma.
Cats eye.
Pitchstone Family.
Obsidian.
Pitchstone.
Pearlstone.
Pumice.
Zeolite Family.
Prehnite.
a. Fibrous.
b. Foliated.
Zeolite.
a. Mealy } Mesotype.
b. Fibrous }
c. Radiated } Stilbite.
d. Foliated }
Cubizite, Chabasie or Analeime.
Cross-stone, Staurolite.
Laumonite.
Dipyre.
Natrolite.
Azurite.
Lazulite.
Hydrargillite.
Feldspar Family.
Andalusite.
Feldspar.
a. Adularia.
b. Labradore stone.
c. Common feldspar.
d. Compact.
e. Hollow spar, eliastolite.
Scapolite.
Arctizite or Wernerite.
Diaspore.
Spodumene.
Meionite.
Sommite.
Ichthyophthalmite.

IV. Argillaceous Genus.
Clay Family.
Native alumina.
Porcelain earth.
Common clay.
a. Loam.
b. Pipe clay.
c. Potters clay.
d. Variegated clay.
e. Slaty clay.
Claystone.
Adhesive slate.
Polishing slate.
Tripoli.
Floatstone.
Alum stone.
Clay Slate Family.
Aluminous schistus.
a. Common.
b. Shining.
Bituminous schistus.
Drawing slate.
Whet slate.
Clay slate.
Mica Family.
Lepidolite.
Mica.
Pinite.
Potstone.
Chlorite.
a. Earthy.
b. Common.
c. Foliated.
d. Schistose.
Trap Family.
Hornblende.
a. Common.
b. Basaltic.
c. Labradore.
d. Schistose.
Basalt.
Wacken.
Phonolite or Clinkstone.
Lava.
Lithomarga Family.
Green earth.
Lithomarga.
a. Friable.
b. Indurated.
Rock soap.
Umber.
Yellow earth.

V. Magnesian Genus.
Soap Stone Family.
Native magnesia.
Bole.
Sea froth.
Fullers earth.
Steatites.
Figure stone.
Talc Family.
Nephrite.
a. Common.
b. Axe-stone.
Serpentine.
a. Common.
b. Precious.
Schillerstone.
Tale.
a. Earthy.
b. Common.
c. Indurated.
Asbestus.
a. Mountain cork.
b. Amianthus.
c. Common asbestus.
d. Ligniform asbestus.
Actynolite Family.
Cyanite.
Actynolite.
a. Asbestous.
b. Common.
c. Glassy.
Tremolite.
a. Asbestous.
b. Common.
c. Glassy.
Smaragdite.
Sahlite.
Schalstone.

VI. Calcareous Genus.
Family of *Carbonates.*
Agarie mineral.
Chalk.
Limestone.
a. Compact.
a'. Common.
b'. Oolite or roe-stone.
b. Foliated.
a'. Granular.
b'. Calcareous spar.
c. Fibrous.
a'. Common.
b'. Calcareous sinter.
d. Pisolite or pea-stone.
Calcareous tufa.
Foam earth.
Slaty spar.
Arragonite.
Brown spar.
Dolomite.
Rhomb or bitter spar.
Swinestone.
Marl.
a. Earthy.
b. Indurated.
Bituminous marl slate.
Family of *Phosphates.*
Apatite.
Asparagus stone.
Phosphorite.
Family of *Fluates.*
Fluor.
a. Earthy.
b. Compact.
c. Fluor spar.
Family of *Sulphates.*
Gypsum.
a. Earthy.
b. Compact.
c. Foliated.
d. Fibrous.
Selenite.
Anhydrite.
Cube spar.

VII. Barytic Genus.
Family of *Carbonates.*
Witherite.
Family of *Sulphates.*
Heavy spar.
a. Earthy.
b. Compact.
c. Granular.
d. Foliated.
e. Common.
f. Columnar.
g. Fibrous.
h. Bolognian.

VIII. Strontian Genus.
Family of *Carbonates.*
Strontites.
Family of *Sulphates.*
Celestine.
a. Fibrous.
b. Foliated.

Second Class.

SALTS.

I. Genus Sulphates.
Native vitriol.
Native alum.
Mountain butter.
Capillary salt.
Native Epsom salt.
Native Glauber salt.

Classification.

II. Genus NITRATES.
Native nitre.
III. Genus MURIATES.
Rock salt.
a. Foliated.
b. Fibrous.
Sea salt.
Native sal ammoniac.
IV. Genus CARBONATES.
Native soda.
Native magnesia.
V. Genus BORATES.
Boracite.
VI. Genus FLUATES.
Cryolite.

THIRD CLASS.

COMBUSTIBLES.

I. Genus SULPHUR.
Native sulphur.
a. Common.
b. Volcanic.
II. BITUMINOUS Genus.
Petroleum, or mineral oil.
Mineral pitch.
a. Elastic.
b. Earthy.
c. Slaggy.
Amber.
a. White.
b. Yellow.
Brown coal.
a. Common.
b. Bituminous wood.
c. Earth coal.
d. Alum earth.
e. Moor coal.
Black coal.
a. Pitch coal.
b. Columnar coal.
c. Slaty coal.
d. Cannel coal.
e. Foliated coal.
f. Coarse coal.
Coal blende.
a. Conchoidal.
b. Slaty.
III. GRAPHITE Genus.
Graphite.
a. Scaly.
b. Compact.
Mineral charcoal.

FOURTH CLASS.

METALLIC ORES.

I. PLATINA Genus.
Native platina.
II. GOLD Genus.
Native gold.
a. Golden yellow.
b. Brass yellow.
c. Gravish yellow.
III. MERCURY Genus.
Native mercury.
Native amalgam.
Corneous ore of mercury.
Liver ore of mercury.
a. Compact.
b. Slaty.
Cinnabar.
a. Common.
b. Fibrous.
IV. SILVER Genus.
Native silver.
a. Common.
b. Auriferous.
Antimonial silver ore.
Arsenical silver ore.
Corneous silver ore.
Sooty silver ore.
Vitreous silver ore.
Brittle vitreous silver ore.
Red silver ore.
a. Dark red.
b. Bright red.
White silver ore.
Black silver ore.
V. COPPER Genus.
Native copper.
Vitreous copper ore.
a. Compact.
b. Foliated.
Variegated copper ore.
Copper pyrites.
White copper ore.
Gray copper ore.
Black copper ore.
Red copper ore.
a. Compact.
b. Foliated.
c. Capillary.
Brick red copper ore.
a. Earthy.
b. Indurated.
Emerald copper ore.
Azure copper ore.
a. Earthy.
b. Indurated.
Malachite.
a. Fibrous.
b. Compact.
Green copper ore.
Ferruginous green copper ore.
a. Earthy.
b. Slaggy.
Micaceous copper ore.
a. Foliated.
b. Lenticular.
Muriate of copper.
VI. IRON Genus.
Native iron.
Iron pyrites.
a. Common.
b Radiated.
c. Capillary.
d. Hepatic.
Magnetic pyrites.
Magnetic iron ore.
a. Common.
b. Arenaceous.
Specular iron ore.
a. Common.
d'. Compact.
b'. Foliated.
b. Micaceous iron ore.
Red iron ore.
a. Red iron froth.
b. Compact.
c. Red hæmatites.
d. Red ochre.
Brown iron ore.
a. Brown iron froth.
b. Compact.
c. Brown hæmatites.
d. Brown ochre.
Sparry iron ore.
Black iron ore.
a. Compact.
b. Black hæmatites.
Argillaceous iron stone.
a. Red chalk.
b. Columnar argillaceous iron stone.
c. Granular.
d. Common.
e. Reniform.
f. Pisiform.
Bog iron stone.
a. Morassy.
b. Swampy.
c. Meadow.
Blue earthy iron stone.
Green earthy iron stone.
VII. LEAD Genus.
Galena.
a. Common.
b. Compact.
Blue lead ore.
Brown lead ore.
Black lead ore.
White lead ore.
Green lead ore.
Red lead ore.
Yellow lead ore.
Native sulphate of lead.
Earthy lead ore.
a. Friable.
b. Indurated.
VIII. TIN Genus.
Tin pyrites.
Common tinstone.
Grained tin ore.
IX. BISMUTH Genus.
Native bismuth.
Vitreous bismuth.
Ochre of bismuth.
X. ZINC Genus.
Blende.
a. Yellow.
b. Brown.
c. Black.
Calamine.
a. Compact.
b. Foliated.
XI. ANTIMONY.
Native antimony.
Gray ore of antimony.
a. Compact.
b. Foliated.
c. Radiated.
d. Plumose.
Red ore of antimony.
White ore of antimony.
Ochre of antimony.
XII. COBALT Genus.
White cobalt ore.
Gray cobalt ore.
Shining cobalt ore.
Black cobalt ochre.
a. Friable.
b. Indurated.
Brown cobalt ochre.
Yellow cobalt ochre.
Red cobalt ochre.
a. Earthy.
b. Radiated.
XIII. NICKEL Genus.
Copper-coloured nickel.
Nickel ochre.
XIV. MANGANESE Genus.
Gray ore of manganese,
a. Radiated.
b. Foliated.
c. Compact.
d. Earthy.
Black ore of manganese.
Red ore of manganese.
XV. MOLYBDENA Genus.
Sulphuret of molybdena.
XVI. ARSENIC Genus.
Native arsenic.
Arsenical pyrites.
a. Common.
b. Argentiferous.
Orpiment.
a. Yellow.
b. Red.
Native oxide of arsenic.
XVII. TUNGSTEN Genus.
Wolfram.
Tungstate of lime.
XVIII. TITANIUM Genus.
Menachanite.
Octahedrite.
Titanite.
Nigrine.
Brown ore.
Iserine.
XIX. URANIUM Genus.
Pitchy ore.
Micaceous uranite.
Uranite ochre.
XX. TELLURIUM Genus.
Native tellurium.
Graphic ore.
Yellow ore.
Black or foliated ore.
XXI. CHROMIUM Genus.
Needle ore.
Ochre of chromium.
XXII. COLUMBIUM Gen.
XXIII. TANTALIUM Gen.
XXIV. CERIUM Genus.

1. GENUS.

Diamond genus.

I. Genus. DIAMOND.

One Species. Diamond.

Id. Kirwin, I. 393. *Le Diamant*, Brochant, II. 153. Haüy, III. 287.

Essential character.—Scratches all other minerals.

External characters.—Its most common colours are grayish white and yellowish white; smoke gray and yellowish gray; clove brown; sometimes asparagus green, passing to pistachio green and apple green; sometimes a wine yellow and citron yellow, and also blue and rose red.

When the diamond is cut, it presents a splendid and varied play of colours, which is one of its most striking characters.

It is found sometimes in rounded grains, which are supposed to have been crystals with the edges worn; but it is most frequently met with crystallized.

The primitive form is a regular octahedron, the integrant molecule a regular tetrahedron; but the form which it commonly assumes is the spheroidal, with 48 curvilineal faces, six of which correspond to the same face of the primitive octahedron. Besides this form there are various others, as the double three-sided pyramid, the dodecahedron, &c. All the modifications of the crystals of the diamond, Haüy observes, seem to be the effects of its tendency to crystallize in a regular figure of 48 plane faces, which, if it ever has existed, has not yet been discovered; and it is easy to conceive that this form would be produced by intermediate decrements on all the angles of the nucleus; but the deviations from this form seem to have been occasioned by its precipitate formation.

The external lustre is from four to one; internal four. The fracture is straight foliated, with a fourfold cleavage, parallel to the faces of the octahedron; transparency four to three; hardness ten; brittle; specific gravity 3.518 to 3.600. Becomes positively electric by friction, even before it is polished.

Chemical character.—When exposed to a sufficient temperature, it is entirely consumed. This has been fully ascertained by the experiments of modern chemists, from which it is concluded, that the diamond is entirely composed of pure carbone. See Chemistry.

Mr Boyle was the first, according to Henckel, who subjected the diamond to the action of heat, and in his experiments he found that it exhaled very copious and acrid vapours. This was about the year 1673; but in the year 1694 the experiment was repeated by the order of Cosmo III. grand duke of Tuscany. Diamonds were exposed to the heat of the powerful burning glass of Tschirnhausen, the action of which was even aided by means of another burning glass; and about the end of 30 seconds a diamond of 20 grains lost its transparency, separated into small pieces, and was at last entirely dissipated. The same experiment was repeated on other diamonds, always with the same result, and without exhibiting the least sign of fusion. Newton, in his treatise on Optics, has placed the diamond among combustibles, supposing that it is a coagulated unctuous substance. He had been led to this by observing its extraordinary refractive power, which in combustible bodies he found to be in a ratio considerably higher than their density. According to this general law he concluded, that the diamond as well as water contained an inflammable principle, both of which have since been verified. Newton's treatise was not published till 1704; but it appears that part of it was composed and read to the Royal Society in the year 1675, nearly 20 years before the Florentine experiments were made. Classification.

But nearly 70 years before this latter period, Boetius de Boodt, in his History of Stones, appears to have been perfectly satisfied, from an experiment which he describes, that the diamond was of an inflammable nature. This document, which we presume will gratify the curiosity of many of our readers, is too singular to be omitted. "Mastix deinde calefieri parum, quemadmodum et adamas debet, idque, ut impositus ac supra positus mastici statim illi unione vera uniatur, ac vivos undique radios a se jaceat. Hanc unionem respuunt aliæ omnes gemmæ diaphanæ—cur vero legitimus adamas solus tincturam illam recipiat, aliæ gemmæ non, difficile est scire. Existimo mutuum illum et amicum amplexum *propter similitudinem aliquam quam habent in materia et qualitatibus;* hoc est, tota utriusque natura fieri, quod itaque mastix *quæ igneæ naturæ est* adamanti facile jungi possit, signum est; id propter materiæ similitudinem fieri, *ac adamantis materiam igneam, et sulphurcam esse*, atque ipsius humidum intrinsicum et primogenium cujus beneficio coagulatus est, *plane fuisse oleosum et igneum*, aliarum vero gemmarum aqueum.—Non mirum itaque si pinguis, oleosa, et iguea masticis substantia illi absque visus termino adpingi et applicari, aliis vero gemmis non possit." *Boetius de Boodt, Gem. et Lapid. Hist.* Hanoviæ, 1609. 4to. lib. ii. cap. 1.

For the sake of the English reader we shall translate this curious document. "If mastich and the diamond be exposed to heat, and brought into contact, they enter into perfect union, and emit a very lively flame, which does not take place in any other gem. But what is the reason that the diamond alone possesses this property? I am of opinion that this mutual combination arises from a certain resemblance which each of the substances possesses in its nature and properties: on this account, therefore, the mastich, which is of a combustible nature, may be united to the diamond from a similarity in their nature, which shows that the diamond is composed of *combustible* and sulphureous matter; and that the humid and original particles of its composition, by means of which it was coagulated, or assumed a solid form, have been decidedly of an oily and *inflammable* nature, while those of other gems have been of an aqueous nature. It is not, therefore, surprising that the fat, oily, and combustible substance of mastich may enter into intimate union with the diamond, but cannot be combined with other gems."

Localities, &c.—The diamond is found in various places of the East Indies, as in the provinces of Golconda and Visapour, in the peninsula of Hither India; and in the kingdoms of Pegu and Siam, in the peninsula of Farther India, and nearly, it is observed, in the same degree of latitude. In 1728 the diamond was discovered in Brasil, in the district of Serro-do-Frio, which is situated in the same southern latitude as the countries which produce the diamond on the north side of the equator. The native repository of the diamond, so far as is known, is a ferruginous soil, but whether it

be

Classification.

be produced on the spot where it is discovered, or have been transported from the place of its origin, has not been ascertained. It is found also in veins filled with soil of a similar nature. We shall here add a short history of the diamond mines.

15 Diamond mines.

The diamond mines are found only in the kingdoms of Golconda, Visapour, Bengal, the island of Borneo, and Brasil. There are four or five mines, or rather three mines and two rivers, whence diamonds are obtained. The mines are, 1. That of Raolconda, in the province of Carnatica, five days journey from Golconda, and eight from Visapour. It has been discovered about 200 years. 2. That of Gani, or Coulour, seven days journey from Golconda eastward. It was discovered 150 years ago by a peasant, who digging in the ground found a natural fragment of 25 carats. 3. That of Soumelpour, a large town in the kingdom of Bengal, near the Diamond-mine. This is the most ancient of all: it should rather be called that of *Goual*, which is the name of the river, in the sand whereof these stones are found. 4. The fourth mine, or rather the second river, is that of Succudan, in the island of Borneo; and, 5. That of Serro-do-Frio in Brasil.

Diamond-mine of Raolconda.—In the neighbourhood of this mine the earth is sandy, and full of rocks and copse-wood. In these rocks are found several little veins of half and sometimes a whole inch broad, out of which the miners, with a kind of hooked irons, draw the sand or earth wherein the diamonds are; breaking the rocks when the vein terminates, that the track may be found again, and continued. When a sufficient quantity of earth or sand is drawn forth, they wash it two or three times, to separate the stones. The miners work quite naked, except a thin linen cloth before them; and besides this precaution, have likewise inspectors, to prevent their concealing diamonds, which, however, they frequently find means to do, by watching opportunities when they are not observed, and swallowing them.

Diamond-mine of Gani or Coulour.—In this mine are found a great number of diamonds from 10 to 40 carats, and even more. It was here that the famous diamond of the Great Mogul, which before it was cut weighed 793 carats, was found. The diamonds of this mine are not very clear: their water is usually tinged with the quality of the soil; being black where that is marshy, red where it partakes of red, sometimes green and yellow, if the ground happen to be of those colours. Another defect of some consequence is a kind of greasiness appearing on the diamond, when cut, which takes off part of its lustre.—There are usually no less than 60,000 persons employed in this mine.

When the miners have found a place where they intend to dig, they level another somewhat bigger in the neighbourhood thereof, and inclose it with walls about two feet high, only leaving apertures from space to space, to give passage to the water. After a few superstitious ceremonies, and a kind of feast which the master of the mine makes for the workmen, to encourage them, every one goes to his business, the men digging the earth in the place first discovered, and the women and children carrying it off into the other walled round. They dig a few feet deep, and till such time as they find water. Then they cease digging; and the water thus found serves to wash the earth two or three times, after which it is let out at an aperture reserved for that end. This earth being well washed, and well dried, they sift it in a kind of open sieve, and lastly, search it well with the hands to find the diamonds. This mine is in a plain of about one league and a half in extent, bounded on one side by a river, and on the other by a range of lofty mountains, which form a semicircle. It is said that the nearer the digging is carried to the mountains, the diamonds are the larger.

Diamond genus.

Diamond-mine of Soumelpour, or river Goual.—Soumelpour is a considerable town near the river Goual, which runs into the Ganges. It is from this river that all our fine diamond points, or sparks, called *natural sparks*, are brought. They never begin to seek for diamonds in this river till after the great rains are over, that is, after the month of December; and they usually even wait till the water is grown clear, which is not before January. The season at hand, eight or ten thousand persons, of all ages and sexes, come out of Soumelpour and the neighbouring villages. The most experienced among them search and examine the sand of the river, and particularly where it is mixed with pyrites, going from Soumelpour to the very mountain whence it springs. When all the sand of the river, which at that time is very low, has been well examined, they proceed to take up that wherein they judge diamonds likely to be found; which is done after the following manner: They dam the place round with stones, earth, and fascines, and throwing out the water, dig about two feet deep: the sand thus got is carried into a place walled round on the bank of the river. The rest is performed after the same manner as at other mines.

Diamond-mine in the island of Borneo, or river of Succudan.—We are but little acquainted with this mine; strangers being prohibited from having access to it: though very fine diamonds have been brought to Batavia by stealth. They were formerly imagined to be softer than those of the other mines; but experience shows they are in no respect inferior.

Diamond-mine of Serro-do-Frio.—A description of this mine was given by D'Andrada in 1792, to the Natural History Society of Paris. The mine is situated to the north of Villa Rica, in the 18th degree of south latitude. The whole country in which the diamonds are found abounds with ores of iron; and the stratum of soil, immediately under the vegetable soil, contains diamonds disseminated in it, and attached to a gangue or matrix which is more or less ferruginous; but they are never found in veins.

When this mine was first discovered, the searching for diamonds was so successful, that the Portuguese fleet which arrived from Rio de Janeiro in 1730 brought no less than 1146 ounces of diamonds. This unusual quantity introduced into the market immediately reduced the price; and to prevent this circumstance recurring, the Portuguese government determined to limit the number of men employed in the mines.

16 Method of cutting and polishing diamonds.

As the diamond is the hardest of all substances, it can only be cut and polished by itself. To bring it to that perfection which augments its price so considerably, the lapidaries begin by rubbing several against each other, while rough; after having first glued them to the ends of two wooden blocks, thick enough to be held

Diamond genus.

held in the hand. It is this powder thus rubbed off the stones, and received in a little box for the purpose, that serves to grind and polish them.

Diamonds are cut and polished by means of a mill, which turns a wheel of soft iron sprinkled over with diamond-dust mixed with oil of olives. The same dust, well ground, and diluted with water and vinegar, is used in the sawing of diamonds; which is performed with an iron or brass wire, as fine as a hair. Sometimes, in lieu of sawing the diamonds, they cleave them, especially if there be any large shivers in them.

The method of cutting and polishing the diamond was not discovered till the 15th century. The diamonds which were employed as ornaments before that period, were in their rough and natural state. The invention is ascribed to Louis Berguen, a native of Bruges, who in the year 1476, cut the fine diamond of Charles the Bald, duke of Burgundy, which he lost the same year at the battle of Morat. This diamond was then sold for a crown, but afterwards came into the possession of the duke of Florence.

The *first water* in diamonds means the greatest purity and perfection of their complexion, which ought to be that of the purest water. When diamonds fall short of this perfection, they are said to be of the *second* or *third* water, &c. till the stone may be properly called a *coloured one*.

17 Of estimating.

The value of diamonds is estimated by Mr Jefferies by the following rule. He first supposes the value of a rough diamond to be settled at 2l. per carat, at a medium; then to find the value of diamonds of greater weights, multiply the square of their weight by 2, and the product is the value required. *E. g.* to find the value of a rough diamond of two carats: $2\times2=4$, the square of the weight; which, multiplied by two, gives 8l. the true value of a rough diamond of two carats. For finding the value of manufactured diamonds, he supposes half their weight to be lost in manufacturing them; and therefore, to find their value, we must multiply the square of double their weight by 2, which will give their true value in pounds. Thus, to find the value of a wrought diamond weighing two carats; we first find the square of double the weight, viz. $4\times4=16$; then $16\times2=32$. So that the true value of a wrought diamond of two carats is 32l. On these principles Mr Jefferies has constructed tables of the price of diamonds from 1 to 100 carats.

18 Celebrated diamonds.

The greatest diamond ever known in the world is one belonging to the king of Portugal, which was found in Brasil. It is still uncut: and Mr Magellan informs us, that it was of a larger size; but a piece was cleaved or broken off by the ignorant countryman, who chanced to find this great gem, and tried its hardness by the stroke of a large hammer upon the anvil.

This prodigious diamond weighs 1680 carats: and although it is uncut, Mr Romé de l'Isle says, that it is valued at 224 millions sterling; which gives the estimation of 79,36 or about 80 pounds sterling for each carat: viz. for the multiplicand of the square of its whole weight. But even in case of any error of the press in this valuation, if we employ the general rule above mentioned, this great gem must be worth at least 5,644,800 pounds sterling, which are the product of 1680 by two pounds, viz. much above five millions and a half sterling. But this gem is supposed by some to be a white topaz.

Classification.

The famous diamond which adorns the sceptre of the empress of Russia under the eagle at the top of it weighs 779 carats, and is worth at least 4,854,728 pounds sterling, although it hardly cost 135,417 guineas. This diamond was one of the eyes of a Malabarian idol, named *Scharingham*. A French grenadier, who had deserted from the Indian service, contrived so well as to become one of the priests of that idol, from which he had the opportunity to steal its eye: he run away to the English at Trichinopoly, and thence to Madras. A ship-captain bought it for twenty thousand rupees: afterwards a Jew gave seventeen or eighteen thousand pounds sterling for it: at last a Greek merchant named *Gregory Suffras*, offered it to sale at Amsterdam in the year 1766: and Prince Orloff made this acquisition for his sovereign the empress of Russia. This diamond is of a flattened oval form and of the size of a pigeon's egg.

The diamond of the Great Mogul is cut in rose; weighs $279\frac{9}{16}$ carats, and it is worth 380,000 guineas. This diamond has a small flaw underneath near the bottom: and Tavernier, page 389, who examined it, valued the carat at 150 French livres. Before this diamond was cut, it weighed $793\frac{5}{8}$ carats, according to Romé de l'Isle: but Tavernier, page 339, of his second volume, says that it weighed 900 carats before it was cut. If this be the very same diamond, its loss by being cut was very extraordinary.

Another diamond of the king of Portugal, which weighs 215 carats, is extremely fine, and is worth at least 369,800 guineas.

The diamond of the grand duke of Tuscany, now of the emperor of Germany, weighs $139\frac{1}{2}$ carats; and is worth at least 109,520 guineas. Tavernier says, that this diamond has a little hue of a citron colour; and he valued it at 135 *livres tournoises* the carat. Robert de Berquen says, that this diamond was cut into two: that the grand Turk had another of the same size: and that there were at Bisnagar two large diamonds, one of 250 and another of 140 carats.

The diamond of the late king of France, called the *Pitt* or *Regent*, weighs $136\frac{1}{4}$ carats: this gem is worth at least 208,333 guineas, although it did not cost above the half of this sum. Patrin says, that it is believed to be at Berlin, (I. 226.) and we may add, that it has probably been carried back to France among other spoils.

The other diamond of the same monarch, called the *Sancy*, weighs 55 carats; it cost 25,000 guineas: and Mr Duten says, that it is worth much above that price.

Brilliant DIAMOND, is that cut in faces both at top and bottom; and whose table, or principal face at top, is flat. To make a complete square brilliant, if the rough diamond be not found of a square figure, it must be made so; and if the work is perfectly executed, the length of the axis will be equal to the side of the square base of the pyramid.—Jewellers then form the table and collet by dividing the block, or length of the axis, into 18 parts. They take $\frac{5}{18}$ from the upper part, and $\frac{1}{18}$ from the lower. This gives a plane at $\frac{4}{18}$ distance from the girdle for the table; and a smaller plane at $\frac{5}{18}$ distance from the collet; the breadth of which will

be

Classification.

be $\frac{1}{3}$ of the breadth of the table. In this state the stone is said to be a *complete square table* diamond.—The brilliant is an improvement on the table-diamond, and was introduced within the 17th century according to Mr Jefferies.

II. Genus. ZIRCON.

1. Species. Zircon.

Jargon, Kirw. I. 257. *Zircon*, Haüy. II. 465. *Id.* Brochant, I. 159.

Essen. Char.—Its specific gravity about 4.4; the joints natural, some of which are parallel, and others are oblique to the axis of the crystals.

Exter. Char.—Colours reddish and yellowish, greenish, greenish yellow, and whitish. The colour in general varies from green to gray, and is most commonly pale; and the polished stone exhibits in some degree the play of colours of the diamond.

It is found in rounded, angular, or flattened grains, or in small angular fragments with notched edges, and also crystallized. The primitive form is an octahedron with isosceles triangles, and the integrant molecule is an irregular tetrahedron. The following are the most common forms of its crystals.

1. A prism with four rectangular faces, each base of which has a pyramid with four faces placed on the four lateral faces, which terminates sometimes in a line, but most frequently in a point.

2. The preceding crystal, in which the opposite lateral edges of the prism are truncated.

3. The crystal (1.) in which the edges of the faces of the pyramid are bevelled.

4. The crystal (1.) having the lateral edges of the prism, and the summit of the pyramid truncated.

5. The crystal (1.) in which the angles between the prism and the pyramid are bevelled.

6. A prism with four faces, having the two opposite narrow, and the two others broad.

7. A double pyramid with four faces, with the edges of the common base truncated.

8. The perfect octahedron with obtuse angles.

The crystals are commonly small; the surface smooth, but that of the angular fragments is rough. Lustre, 3 and 4; internal lustre 4 and 3; somewhat vitreous, or approaching to that of the diamond. Fracture imperfect or flat conchoidal; fragments, 3. Transparency, 4, 3. Causes double refraction. Hardness, 9; brittle. Spec. grav. 4.416 to 4.4700.

Chem. Char.—Infusible by the blow-pipe without addition, but with borax it forms a transparent colourless glass. The following are its constituent parts.

Zirconia,	70
Silica,	26
Iron,	1
Loss,	3
	100

Localities.—The zircon was first found in Ceylon, accompanied with crystals of spinelle and tourmaline, in a river near the middle of the island; and more lately it has been found in Norway, in a rock composed of feldspar and hornblende.

Zircon genus.

Uses.—The zircon is employed as a precious stone, and particularly as an ornament in mourning.

2. Species. Hyacinth.

Id. Kirw. I. 257. *Zircon*, Haüy, II. 465. *L'Hyacinthe*, Brochant, I. 163.

Essen. Char.—The same as the first species.

Exter Char.—The most common colour is what is called hyacinth red, blood red, and yellowish brown.

It is found in rounded grains, and frequently in crystals, the primitive form of which is the same as the first species. The crystals are,

1. A prism with four faces.

2. The same slightly truncated on its edges.

3. The double pyramid with four faces, or a very obtuse octahedron, which is a rare variety.

4. A prism with six faces, each base of which is terminated by an acumination with three faces, placed alternately on the three lateral edges, forming the rhomboidal dodecahedron.

The crystals are commonly small, the surface smooth; external lustre, 3, 4; internal, 4; greasy, fracture straight foliated; cleavage double, rectangular; fragments, 3; transparency, 4, 2; causes double refraction; hard and brittle; unctuous to the touch when cut; spec. grav. 4.385 to 4.620.

Chem. Char.—By the action of the blow-pipe the hyacinth loses its colour, but retains its transparency. It is infusible without borax, which converts it into a transparent colourless glass.

Constituent Parts.

	From Ceylon.	From Expailly.	
Zirconia,	70	64.5	66
Silica,	25	32	31
Oxide of iron,	0.5	2	2
Loss,	4.5	1.5	1
	100 Klap.	100 Vauq.	100 Vauq.

Localities.—It is found in Ceylon in similar situations with the former; in Brazil, Bohemia, and in the rivulet Expailly, in Velay in France; and also in the neighbourhood of Pisa in Italy.

Uses.—As it is susceptible of a fine polish, the hyacinth has been ranked among precious stones.

Remarks.—The analogy between the crystalline forms of the zircon and hyacinth; their double refraction; the similarity of their other characters, and particularly the results of chemical analysis, have led Haüy to form them into one species.

A variety, under the name of *cinnamon stone*, has been considered as a distinct species; but the differences are so very slight, that it may be included in the description of the preceding.

III. Genus. SILICEOUS.

1. Species. Chrysoberyl.

Id. Emm. Wid. Lenz. Kirw. *Chrysopale*, Lam. *Cymophane*, Haüy.

Exter. Char.—The colour is an asparagus green; passing

Siliceous genus.

passing sometimes to a greenish white, and sometimes to an olive green; sometimes bright brown and yellowish brown, passing to yellowish gray; affords a feeble change of colour from bluish to milky white.

It is found in angular or rounded grains, which appear to have been water worn; and in crystals, exhibiting, 1. A table with six faces, elongated, of various thickness, truncated on the terminal edges. 2. A prism with four rectangular faces. 3. A prism with six faces, of which four are broader and two are narrower opposite to each other.

The grains are slightly rough, and have a considerable external lustre. The crystals are striated lengthwise on their lateral faces; the other faces are smooth; lustre external very shining—internal the same, intermediate between that of the diamond and the vitreous lustre.

The fracture is in all directions perfectly conchoidal; the fragments are indeterminate with sharp edges. It has little transparency, but a considerable degree of hardness. Spec. grav. 3.698 to 3.719 Wern. 3.710 Klap. 3.796 Hauy.

Chem. Char.—It is infusible without addition by the action of the blow-pipe. By Klaproth's analysis, the following are its constituent parts.

Alumina,	71.5
Silica,	18
Lime,	6
Oxide of iron,	1.5
Loss,	3
	100

Localities.—Brazil, Ceylon, Siberia.

Uses.—The hardness of the chrysoberyl, and change of colour which it exhibits, have procured it a place among precious stones of inferior value. It is known in commerce under the name of *changeable opal* or oriental chrysolite.

2. Species. CHRYSOLITE.

Id. Emm. Wid. Lenz. Mus. Lesk. Kirw. *Peridot*, Daub. Hauy.

Exter. Char.—The most common colour is a bright pistachio green, passing to an olive green; sometimes of a bright asparagus or clear meadow green; rarely the green approaches to brown and almost to a cherry red.

It is found in angular fragments with the edges a little notched, or in rounded grains, or in crystals having the angles and edges a little notched. The forms of its crystals are, 1. A large rectangular prism having its lateral edges truncated and sometimes bevelled, and terminated by a six-sided prism, of which two opposite sides are placed on the small lateral faces of the prism. The four others on the lateral truncated faces, the latter forming a more acute angle than the two former.

2. The next form varies from the preceding, in having two additional terminating faces, placed on the broad faces of the prism, each of which is consequently situated between two of the planes corresponding to the truncated planes.

Classification.

3. In another variety the summit of the pyramid is truncated by a convex cylindrical plane, the convexity of which passes from one of the small opposite lateral planes towards the other.

4. In some instances the crystals are so small, that the same lateral faces almost entirely disappear, while the two larger assume a curved form, giving such crystals a tabular appearance.

The external surface of the angular fragments and of the rounded crystals is scaly, which affords an essential character to this mineral. The small lateral planes are smooth, the broad ones are distinctly striated lengthwise. Externally the surface is shining; internally shining and vitreous.

The fracture in all directions is perfectly conchoidal; the form of the fragments is indeterminate, with very sharp edges. It is almost always transparent, and refracts double; it is not so hard as quartz. Brittle. Spec. grav. 3.340 to 3.420 Wern. 3.428 Hauy.

Chem. Char.—By the action of the blow-pipe it is fused with borax without effervescence, and affords a greenish, transparent glass.

Constituent parts.

	Crystallised.	Cut.	Crystallised.
Silica,	38	39	38
Magnesia,	39.5	43.5	50.5
Oxide of iron,	19.	19	9.5
Loss,	3.5		2.
	100 Klap.	100.5 Vanq.	100 Vauq.

Localities, &c.—This mineral is brought from the Levant, but it is not known whether it is found in Asia or Africa. It has been discovered in Bohemia; and crystallised specimens included in a kind of lava have been brought from the isle of Bourbon. As it is usually found in rounded fragments, in the midst of earthy substances, its relative situation is scarcely known.

Uses.—The chrysolite has been often employed for various purposes as a precious stone, but as it possesses no great degree of hardness, it is not much esteemed.

Substances of a very different nature have been, at different times, described under the name of *Chrysolite*. It appears that the yellow chrysolite of the ancients is the same with our topaz, and that their green topaz is our chrysolite. Plin. lib. xxxvii. cap. 8.

3. Species. OLIVINE.

Id. Emm. Wid. Lenz. Kirw. Lameth. *Chrysolite en grains irreguliers*, De Born. *Peridot Granuliforme*, Hauy. *Chrysolith des Volcans*, of many mineralogists.

Exter. Char.—The most common colour is a bright olive green, sometimes of an apple green, pistachio, or mountain green; a wine, honey, or orange yellow, and sometimes also a reddish brown, and brownish black; but these latter varieties are rare. It is found in rounded pieces, from the size of the head to that of a grain of millet, most commonly included, and disseminated in basalt. It has been found crystallized.

Internally,

Classification.

Internally, this mineral varies in its lustre between shining and weakly shining; in the yellow varieties the lustre is between vitreous and resinous.

The fracture is more or less conchoidal; sometimes uneven; the shape of the fragments is indeterminate, with sharp edges. The rounded pieces of a certain size are composed of distinct granular concretions, with small grains.

It is sometimes transparent, and varies to semitransparent and translucent. It is brittle, and not so hard as quartz. Spec. grav. 3.225 to 3.265.

Chem. Char.—Olivine is infusible by the action of the blow-pipe; in nitric acid it loses its colour, giving to the liquid a pale yellow colour.

Constituent Parts. Klaproth.

Silica,	48 to	52.0	52
Magnesia,	37	38.5	37.75
Lime,	00.25	00.25	0.25
Oxide of iron,	12.5	12.	10.75
Loss,	2.25		—
	100.00—102.75		100.75

Localities, &c.—Olivine is found in different countries, as in Bohemia and Saxony, and in Vivarais in France, and most commonly in rounded pieces in the cavities of basalt. Brochant says that it has not been discovered in the basalts of Ireland, England, Sweden, Norway, and Italy. We have, however, collected specimens of olivine among the basaltic rocks of the Giant's Causeway in Ireland.

Olivine and chrysolite are considered by Hauy as one species, and described under the name peridot.

4. Species. Coccolite.

Coccolithe, Brochant, ii. 504. Haüy, iv. 355. D'Andrada. Nich. 4to. Jour. v. 495.

Exter. Char.—Colour, meadow green, olive, or blackish green. It is found in masses which are composed of separate pieces, granular, in small grains, which may be easily separated; these grains are angular, and discover some appearance of tendency to crystallization.

Lustre, resplendent, vitreous; fracture foliated; cleavage double, as examined by Haüy, but single according to D'Andrada: it is hard, scratches glass; the grains are often translucent. Spec. grav. 3.316 to 3.373.

Chem Char.—Coccolite is infusible without addition before the blow-pipe. With borax it melts into a pale yellow transparent glass, and with carbonate of potash into an olive green vesicular glass.

Constituent Parts.

Silica,	50.0
Lime,	24.0
Magnesia,	10.0
Oxide of iron,	7.0
Oxide of manganese,	3.0
Alumina,	1.5
Loss,	4.5
	100

Localities.—It is found in the iron mines of Hellesta and Assebo in Sudermania, at Nerica in Sweden, and near Arendal in Norway. Siliceous genus.

5. Species. Augite.

Octahedral Basaltine, Kirw. i. 219. *L'Augite*, Brochant, i. 179. *Pyroxene*, Haüy, iii. 80.

Essen. Char.—Divisible, parallel to the sides of an oblique rhomboidal prism, of about 92° and 88°, which is subdivided in the direction of the great diagonals of the bases.

Exter. Char.—Colour, olive green, black, white, and gray. It is found sometimes in rounded pieces, and in grains, but most frequently crystallized. The primitive form is an oblique-angled prism, the bases of which are rhombs: the integrant molecule is an oblique triangular prism. The form of the crystals is generally a six and eight-sided prism, which is terminated by a two-sided summit. The crystals are commonly small, smooth, and brilliant, sometimes a little shining. Internal lustre shining, and almost resplendent, resinous. Fracture perfectly foliated; cleavage double; translucent at the edges; harder than olivine; gives lively sparks with steel, and scratches glass; rather brittle; spec. grav. 3.226 to 3.777.

Chem. Char.—Fusible before the blow-pipe with difficulty, and only in small fragments, which melt into a black enamel.

Constituent Parts.

	From Ætna. Vauquelin.	From Arendal, Roux
Silica,	52	45
Lime,	13.20	30.5
Alumina,	3.33	3
Magnesia,	10	
Oxide of iron,	14.66	16
Oxide of manganese,	2	5
Loss,	4.81	.5
	100.00	100

Localities, &c.—Augite is found in basalt along with olivine and hornblende, in Bohemia, Hungary, and Transylvania; in the basalt of Arthur's seat near Edinburgh.

6. Species. Vesuvian.

La Vesuvienne, Brochant, i. 184. *Idocrase*. Haüy, ii. 574.

Essen. Char.—Divisible parallel to the faces and diagonals of a rectangular prism, with square bases; melts into a yellow glass.

Exter. Char.—Colour brown, orange, dark green, and yellowish green.

This mineral is found massive, disseminated, or crystallized. Primitive form, a rectangular prism, little different from a cube; integrant molecule a triangular prism. The forms of its crystals are, a rectangular prism, with four sides, truncated on all its edges, or truncated on its lateral edges; or a six-sided prism truncated on all its edges. The crystals are usually small, single sometimes, and sometimes in groups. Lateral planes longitudinally streaked. Some are smooth;

Siliceous genus.

smooth; lustre resplendent, vitreous; internal lustre shining, resinous. Fracture imperfectly conchoidal, sometimes uneven, often also foliated. Fragments indeterminate, with rather sharp edges. Translucent, and almost semitransparent; hard, brittle; specific gravity 3.365 to 3.420.

Chem. Char.—Fusible without addition into a yellow glass.

Constituent Parts. Klaproth.

	From Vesuvius.	From Siberia.
Silica	35.50	42
Lime,	33.	34
Alumina,	22.25	16.25
Oxide of iron,	7.5	5.50
Oxide of manganese,	.25	an atom.

Localities, &c.—It is found in the neighbourhood of Vesuvius, accompanied by limestone in small grains, feldspar, mica, hornblende, and calcareous spar; and it is supposed to have been thrown out of the volcano unchanged. In Siberia it is found in steatites, sometimes mixed with crystals of magnetic iron.

Uses.—At Naples it is employed as a precious stone.

7. Species. Leucite.

La Leucite, Brochant, i. 188. *Vesuvian*, Kirwan, i. 285. *Amphigene*, Haüy, ii. 559.

Essen. Char.—Divisible, parallel to the faces of a cube, and at the same time to those of a rhomboidal dodecahedron.

Exter. Char.—Colour grayish or yellow white.

It is rarely found massive or in grains, but most frequently crystallized. The primitive form of its crystals is the cube; the integrant molecule an irregular tetrahedron; the most common form of the crystals is a short double pyramid with eight faces opposed base to base, each summit of which is surmounted by an obtuse acumination with four faces, corresponding alternately to the four lateral edges of the pyramid, and thus producing a figure of twenty-four trapezoidal faces; the crystals are commonly small, the surface rough and dull, or at most feebly shining. Internal lustre shining, vitreous. Fracture foliated, sometimes conchoidal. Fragments indeterminate with sharp edges. Semitransparent or translucent. Scarcely scratches glass. Brittle. Spec. grav. 2.455 to 2.490.

Chem. Char.—Infusible before the blow-pipe, but with borax gives a transparent glass.

Constituent Parts.

	Klaproth.	Vauquelin.
Silica,	54	56
Alumina,	24	20
Potash,	21	20
Lime,	—	2
Loss,	1	2
	100	100

Localities, &c.—Leucite is found in the lavas of Vesuvius, and in the basalts of Italy; in basalts and other rocks of Bohemia, and also, it is said, in a granitic rock in the Pyrenees.

Classification.

8. Species. Melanite, or *Black Garnet.*

La Melanite, Brochant, i. 191.

Exter. Char.—Colour velvet black, or brownish or grayish black. It is most commonly found crystallized, in six-sided prisms, terminated at each extremity by an obtuse acumination, with three planes placed alternately on three of the lateral edges; the prisms are sometimes truncated on all the edges, and sometimes only the lateral edges. The surface is smooth and shining. Internal lustre shining. Fracture imperfect, flat, conchoidal. Fragments indeterminate, sharp-edged, opaque, hard, and rather brittle. Spec. grav. 3.691 to 3.800.

Constituent Parts. Vauquelin.

Silica,	35
Alumina,	6
Lime,	32
Oxide of iron and of manganese,	25
Loss,	2
	100

Localities.—It has been found only at Frescati and St Albano near Rome.

9. Species. Garnet.

Le Grenat, Brochant, i. 193. *Garnet*, Kirwan, i. 238. *Grenat*, Haüy, ii. 540.

Essen. Char.—Specific gravity at least 3.5. The forms derived from the rhomboidal dodecahedron.

The primitive form is a rhomboidal dodecahedron. The inclination of each rhomb to the two adjacent is 120°, the plain angles 109° 28′ 16″ and 70° 31′ 44″. The integrant molecule is the tetrahedron, whose faces are isosceles triangles equal and similar.

The garnet is divided into three subspecies, the precious, common, and Bohemian garnet.

Subspecies 1. Precious Garnet.

Exter. Char.—Colour red, of which there are several varieties, as blood red, cherry red, hyacinth red, sometimes brown and even black.

The garnet is rarely found massive or disseminated, but sometimes in rounded grains, and most frequently crystallized, of which the following are the forms.

1. A prism with six sides terminated by a double obtuse summit with three faces, corresponding alternately to the three lateral edges at each end of the prism, and thus forming a rhomboid of twelve faces.

2. The same crystal truncated on all its edges, forming a figure of 36 faces. The faces of the truncations are elongated hexagons.

3. A short double pyramid, with eight faces opposed base to base, the summits of each of which are surmounted by an obtuse acumination, corresponding alternately to the four lateral edges of one of the pyramids,

Classification.

mids, forming a crystal of 24 sides, which are pretty equal trapezoids.

4. The preceding form with twelve truncations; eight on the eight acute alternating angles of the two summits, and four on the obtuse angles of the common base of the two pyramids, making in all 36 faces.

The surface is a little unequal in the grains, smooth in the crystals, and almost always streaked diagonally. The lustre varies from shining to resplendent, and is vitreous. Fracture more or less perfectly conchoidal, sometimes uneven or splintery, and sometimes foliated. Fragments indeterminate with sharp edges. Transparent or translucent. Scratches quartz. Refraction simple. Brittle. Spec. grav. 4.085 to 4.352.

Chem Char.—Before the blow-pipe it is fusible into a dark enamel.

Constituent Parts.

	Klaproth.	Vauquelin.
Silica,	35·75	36
Alumina,	27.25	22
Lime,	—	3
Oxide of iron,	36	41
Oxide of manganese,	.25	–
Loss,	.75	–
	100.00	102

Localities, &c.—The garnet is not uncommon in most countries of the world, and it is usually found in primitive rocks.

Uses.—It is employed as a precious stone.

The precious garnet is supposed to be the carbuncle of the ancients.

Subspecies 2. Common Garnet.

Essen. Char.—The same as the precious garnet.

Exter. Char.—It is found massive and disseminated, and also sometimes crystallized. The forms of the crystals are the same as those of precious garnet. The surface of the crystals is diagonally streaked.

Colour brown, green, greenish black, brownish red, and orange yellow. Lustre shining, resinous, or vitreous. Fracture uneven, sometimes splintery. Fragments sharp-edged. Rarely transparent, sometimes translucent, and commonly at the edges; not so hard as the precious garnet. Brittle. Spec. grav. from 3.668 to 3.757.

Chem. Char.—Melts before the blow-pipe into a dark enamel, and easier than the former.

Constituent Parts. Vauquelin.

	Black Garnet.	Yellowish Garnet.
Silica,	43	38
Alumina,	16	20
Lime,	20	31
Oxide of iron,	16	10
Water,	4	–
Loss,	1	1
	100	100

Localities, &c.—The common garnet is found in micaceous schistus, gneis, serpentine, and other primitive rocks, in Saxony, Bohemia, France, Sweden.

Siliceous genus.

Uses.—It is rarely employed as a precious stone, but frequently as a flux for iron ores.

Subspecies 3. Pyrope, or *Bohemian Garnet.*

Pyrope, Brochant, ii. 498.

Essen. Char.—The same as the garnet.

Exter. Char.—This mineral is found in small, round angular fragments: it is never crystallized.

Colour dark blood red, which, by holding it between the eye and the light, becomes yellow. Lustre resplendent, vitreous. Fracture conchoidal. Fragments indeterminate and sharp-edged. Perfectly transparent. Scratches quartz. Spec. grav. 3.718 to 3.941.

Constituent Parts.	Klaproth.
Silica,	40
Alumina,	28.5
Lime,	3·5
Magnesia,	10
Oxide of iron,	16.5
Oxide of manganese,	.25
Loss,	1.25
	100

Localities, &c.—This mineral is found in serpentine in Saxony; the most beautiful are from Bohemia, where it is found in alluvial land.

Uses.—It is employed in jewellery. The small grains are used as a substitute for emery in polishing.

This mineral is formed into a separate species by some, and is distinguished from the garnet by its colour, want of crystallization, and transpareney; but these differences in the external characters Hauy considers as insufficient to constitute a different species of two minerals which agree in a greater number of other characters. Magnesia indeed has been detected in the latter as one of its constituents, no trace of which has been yet discovered in the former.

10. Species. Grenatite.

Grenatite, Brochant, ii. 496. *Id.* Saussure, § 1900. *Staurotide*, Hauy, iii. 93. *Pierre de Croix*, De Lisle, ii. 434.

Essen. Char.—Divisible parallel to the sides of a rhomboidal prism, whose angles are equal to 129° 30′, and 50° 30′, which may be subdivided in the direction of the short diagonals of the bases.

Exter. Char.—Grenatite is always found crystallized. The primitive form is a rectangular prism with rhomboidal bases, having the angles inclined, as mentioned in the essential character. The integrant molecule is a triangular prism. It is frequently met with in double crystals, crossing each other in the form of a cross, from which the name is derived, sometimes at right angles, and sometimes obliquely; sometimes also there are oblique triple crossings. The surface is smooth and shining, or uneven and dull.

The colour is reddish or blackish brown; internal lustre shining, between vitreous and resinous. Fracture

Siliceous genus.

imperfectly foliated, in the direction of the axis; in other directions uneven, small grained, or sometimes a little conchoidal; often opaque, sometimes translucent. Scratches quartz feebly; specific gravity 3.2861.

Chem. Char.—Before the blow-pipe it becomes brown without fusion, and is then converted into a fritty substance.

Constituent Parts.

	Vauquelin.
Silica	33.
Alumina,	44.
Lime,	3.84
Oxide of iron,	13.
Oxide of manganese,	1.
Loss,	5.16
	100

Localities, &c.—It is found is small crystals in micaceous schistus, at St Gothard in Switzerland, in Brittany in France, and in Spain, in primitive rocks.

11. Species. CEYLANITE.

Pleonaste, Hauy, iii. 17. *Spinelle Pleonaste*, Brongniart, i. 438.

Essen. Char.—Scratches glass slightly, and is divisible into a regular octahedron.

Exter. Char.—This mineral is found in rounded masses, and also crystallized. Primitive form of the crystals, a regular octahedron. The integrant molecule a regular tetrahedron. The edges of the octahedron are sometimes truncated, and form a regular 12-sided rhomboid. The crystals are small; the fracture is conchoidal; the lustre shining and vitreous.

The colour is sometimes perfectly black, brown, bright blue, purplish red, or dark green. It is hard, but not very brittle. Spec. grav. 3.76 to 3.79.

Chem. Char.—Infusible before the blow-pipe.

Constituent Parts.	Descotils.
Alumina,	68
Magnesia,	12
Silica,	2
Oxide of iron,	16
Loss,	2
	100

Localities, &c.—This mineral is met with in the island of Ceylon, along with tourmaline and other crystallized substances, which have been carried from their native repositories by means of water. It has been found also in disseminated crystals in the cavities of the lava of Vesuvius; and very small blue crystals of ceylanite have been observed in the volcanic (basaltic) rocks at Closterlach on the banks of the Rhine.

12. Species. SPINELLE.

Spinel and *Balas Ruby*, Kirw. i. 253. *Le Spinel*, Brochant, i. 202. *Spinelle*, Hauy, ii. 496.

Essen. Char.—Scratches quartz strongly; the primitive and common form, a regular octahedron.

Classification.

Exter. Char.—Spinelle is found in rounded grains, or crystallized: the primitive form of the crystals is a regular octahedron; the integrant molecule the regular tetrahedron. Its usual forms are a double pyramid with four faces applied base to base, constituting a perfect octahedron; or it is truncated on all its edges, or only on those of the common base of the two pyramids. It is met with also in the form of a double crystal, composed of two octahedrons, which are often flattened.

Colour usually red, of various shades, from carmine red to rose red; sometimes reddish white, and orange yellow. Faces of the octahedron smooth, those of the truncations longitudinally streaked. Lustre resplendent, vitreous; fracture conchoidal; the longitudinal fracture is foliated; fragments indeterminate, sharp-edged; semitransparent, and sometimes transparent. Scratches quartz; is scratched by sapphire. Spec. grav. 3.570 to 3.645.

Chem. Char.—Before the blow-pipe it is infusible; but with borax it melts, and without frothing up.

Constituent Parts.

	Klaproth.	Vauquelin.
Alumina,	74.50	82.47
Silica,	15.50	—
Magnesia	8.25	8.78
Oxide of iron,	1.50	—
Lime,	.75	—
Chromic acid,	—	6.18
Loss,	—	2.57
	100.5	100

Localities, &c.—Crystals of spinelle are found in Ceylon, in a river which comes from the high mountains in the middle of that island: they are accompanied with zircon, tourmaline, and different other stones. It is found also in Pegu.

Uses.—Spinelle is ranked among precious stones, and is greatly esteemed when it is of a certain size. It is said that a fine spinelle ruby, whose weight exceeds four carats, is worth half the price of a diamond of the same weight.

13. Species. SAPPHIRE.

Oriental Ruby, *Sapphire*, and *Topaz*, Kirwan, i. 250. *Le Saphir*, Brochant, i. 207. *Telesie*, Hauy, ii. 480.

Essen. Char.—Specific gravity about 4; natural joints very distinct, and perpendicular to the axis of the crystals.

Exter. Char.—Sapphire is found in fragments, in rounded pieces, and also crystallized. The primitive form of the crystal, according to Hauy, is a regular six-sided prism, and the integrant molecule is a triangular, equilateral prism; but, according to Bournon, the primitive form is a rhomboid, whose angles are 96° and 84°. The usual forms of the crystals are, 1. A small six-sided prism. 2. A pyramid with six faces, very sharp, double, the two pyramids applied base to base. 3. The same crystal with the summit truncated. 4. A pyramid with six faces, double; the two pyramids applied base to base, but less sharp than the second form. The surface of the crystals is smooth, and often streaked transversely.

The

Classification.

The principal colour is blue, varying between Prussian and indigo blue; other varieties are of a deep violet blue. Sapphires are also found red, yellowish, and greenish. Two or three colours appear in the same crystal, sometimes in bands and sometimes in concentric circles. Externally, the lustre of the sapphire is shining; internally, resplendent and vitreous. Fracture perfectly conchoidal. Fragments sharp-edged; transparent or semitransparent, sometimes only translucent. Scratches all other earthy substances. Brittle. Spec. grav. 3.991 to 4.283.

Chem. Char.—Infusible before the blow-pipe. Melts with borax without intumescence. The blue variety, exposed to a strong heat, loses its colour, Haüy.

Constituent Parts.

	Klaproth.	Bergman.
Alumina,	98.5	58.
Silica,		35.
Lime,	00.5	5.
Oxide of iron.	1.	2.
	100	100

	Sapphire.	Oriental Ruby.
Alumina,	92	90
Silica,	5.25	7
Oxide of iron,	1	1.2
Loss,	1.75	1.8
	100	100

Localities, &c.—The finest sapphires are brought from Pegu and the island of Ceylon. The sapphire is also found in Bohemia, accompanied with zircon, Bohemian garnet, and magnetic iron; and in the river Expailly in France.

Uses.—The sapphire, next to the diamond, is the most highly valued of precious stones.

14. Species. CORUNDUM.

Corindon, Haüy, iii. 1. *Adamantine Spar*, Kirw. i. 335. *Le Spath Adamantin*, Broch. i. 356.

Essen. Char.—Scratches quartz; divisible into a rhomboid somewhat acute.

Exter. Char.—This mineral is found massive, disseminated, and crystallized; 1. In six-sided prisms, having the extremities broken, and the faces sometimes unequal. 2. A six-sided prism, terminated by a six-sided pyramid. 3. A pyramid with six short faces, whose summit is strongly truncated; and, 4. The preceding crystal terminated by a three-sided pyramid. From the investigations of Count de Bournon and Mr Greville, it appears that the crystallization of corundum is similar to that of the sapphire*. Lustre, which is intermediate between resinous and vitreous, shining or weakly shining; cross fracture uneven, or splintery, sometimes foliated; fragments rhomboidal, sometimes sharp-edged.

The colour is greenish white, greenish gray, and asparagus green, translucent at the edges; refraction double. Extremely hard. Spec. grav. 3.710 to 3.873.

Chem. Char.—Entirely infusible before the blow-pipe.

* *Phil. Trans.* 1798.

Siliceous genus.

Constituent Parts. Klaproth.

	From China.	From Bengal.
Silica,	6.5	5.50
Alumina,	84.	89.50
Oxide of iron,	7.5	1.25
Loss,	2.	3.75
	100	100

According to Chenevix.

	From the Carnatic.	From Malabar.
Silica,	5	7
Alumina,	91	86.5
Oxide of iron,	1.5	4
Loss,	2.5	2.5
	100	100

Localities.—Corundum is found in a hard rock near the river Cavery, south of Madras; on the Malabar coast; in the island of Ceylon; in the kingdom of Ava; and in China.

15. Species. ADAMANTINE SPAR.

Exter. Char.—This mineral, which ought undoubtedly to be considered as a variety of corundum, is found massive, in rolled pieces, and crystallized in six-sided prisms, and six-sided acute pyramids with truncated extremities. Internal lustre splendent; fracture foliated; fragments rhomboidal.

Colour dark hair brown; very hard. Spec. grav. 3.981.

Constituent Parts. Klaproth.

	From China.
Silica,	6.5
Alumina,	84.
Oxide of iron,	7.5
Loss,	2.
	100

Localities.—This mineral has been only met with in China.

16. Species. EMERY.

Fer Oxydé Quartzifère, Hauy, iv. 112. *Emery*, Kirw. ii. 193. *L'Emeril*, Broch. ii. 292.

Essen. Char.—The powder scratches all bodies except the diamond.

Exter. Char.—This mineral is found massive and disseminated. The lustre is glimmering or weak shining, and adamantine. Fracture fine-grained, uneven; fragments a little blunt-edged.

Colour grayish black, bluish, smoke or steel gray; generally opaque, but sometimes translucent at the edges: extremely hard. Spec. grav. about 4.

Chem. Char.—Becomes black under the blow-pipe, but is infusible. Colours borax of a dirty yellow

Corundum

Siliceous genus.

Classification.

Constituent Parts.

	Tennant.
Alumina,	86
Silica,	3
Oxide of iron,	4
Loss,	7
	100 *

* *Phil. Trans.* 1802. p. 400.

Localities, &c.—This mineral is found in Saxony, disseminated in a bed of indurated steatites, mixed with common talc; also in the island of Naxos in the Archipelago; and in Italy, Spain, and Peru.

Uses.—Emery, as well as the two former species, is employed, when reduced to powder, in cutting and polishing hard stones, glass, and metals.

Not only the external characters, but also the near approach in the proportion of their constituent parts, of the three species last described, would lead to consider them as the same species, or at least as varieties. Emery is by some mineralogists arranged among the ores of iron.

17. Species. TOPAZ.

Occidental Topaz, Kirw. i. 254. *La Topaze*, Broch. i. 212. *Topaze*, Hauy, ii. 504.

Essen. Char.—Refraction double; joints very distinct; perpendicular only to the axis of the crystals.

Exter. Char.—The topaz is sometimes found massive, sometimes disseminated, and sometimes in rounded fragments; but it is most commonly crystallized. The primitive form of its crystals is a right-angled prism, whose bases are rhombs, and having the large angle 124° 22′; the integrant molecule is the same. The most common forms of the topaz are,

1. A prism with eight sides, terminated at the one end by a four-sided summit, and at the other (which but rarely happens), by one of a different form. In a variety of the Brazilian topaz, the one summit presents six sides, and the other ten; and the electricity exhibited by the latter by means of heat, is negative, while that of the former is positive. This difference in the two opposite summits of a crystal, as has been observed by Hauy, is a peculiarity in all crystals which acquire by means of heat two kinds of electricity.

2. The next common form of the topaz is an eight-sided prism, whose base is horizontal, and bordered with a row of six oblique faces. This variety, which is found in the mines of Saxony, becomes readily electric by friction, but not by heat.

The prevailing colour of the topaz is yellow of various shades. The crystals are of middling size; their lateral faces are sometimes convex and cylindrical; the surface of the same face is longitudinally striated, while that of the other faces is smooth. Lustre vitreous; cross fracture perfectly foliated; longitudinal fracture conchoidal; fragments indeterminate; transparent; sometimes semitransparent or translucent; refraction double; scratches rock-crystal. Spec. grav. 3.464 to 3.564.

Chem. Char.—Infusible before the blow-pipe, but melts with borax without intumescence. The Brazilian topaz heated in a crucible assumes a rose red colour, when it is called by the jewellers *ruby of Brazil*. The Saxon topaz becomes white when exposed to heat; and thus deprived of colour, is sold for the diamond. According to Vauquelin, all the varieties of topaz reduced to powder, and added to syrup of violets, at the end of two or three hours communicate a green colour.

Constituent Parts.

According to Klaproth and Vauquelin.

Alumina,	47	to	50
Silica,	28	to	30
Fluoric acid,	17	to	20
Iron,	0	to	4

Localities, &c.—The topaz is found in different parts of Saxony, particularly in the mountain Schneeckenstein, which is denominated *topaz rock*, and is arranged with the primitive mountains. In this rock the topaz is mixed with quartz, schorl, mica, and lithomarga. Near Zinnwald it is found in granite. It is also found mixed with ores of tin. In Siberia the topaz is found in graphic granite, accompanied with beryl, quartz, and garnet. Topaz is also met with in Brazil and Asia Minor.

Uses.—The topaz is employed for the purposes of jewellery as a precious stone, but it is not considered of very great value.

18. Species. PYROPHYSALITE.

This mineral which was described and analysed by Hisenger and Berzelius, is of a greenish-white colour. When thrown on hot coals it becomes phosphorescent, and gives out a greenish flame. When it is strongly heated by the action of the blow-pipe, the surface is covered with small vesicles which explode. These phenomena are ascribed to the fluate of lime which forms one of its constituent parts, and which sometimes appears surrounding it with a crust.

Localities, &c.—Gahn found this stone at Finbo near Fahlun in Sweden, in nodules imbedded in a granite, composed of white quartz, feldspar, and silvery mica. The nodules are separated from the rock by a greenish yellow talc †.

† *Brongniart*, ii. 401.

19. Species. EUCLASE.

Id. Hauy, ii. 531. *Id.* Brochant, ii. 508.

Essen. Char.—Divisible by two longitudinal lines perpendicular to each other.

Exter. Char.—This mineral has only been found crystallized. The primitive form of the crystals is a rectangular prism with square bases, and that of the integrant molecule is the same. The most common form under which it appears is an oblique four-sided prism, with the edges truncated in various ways. The crystals are streaked longitudinally. The lustre is resplendent and vitreous. Longitudinal fracture foliated; cross fracture conchoidal.

Colour, bright sea green. Transparent, and refracts double. Scratches quartz. Very frangible; hence its name signifying easily broken. Spec. grav. 3.062.

Chem. Char.—Loses its transparency before the blow-pipe, and melts into a white enamel.

Constituent

Classification.

Siliceous genus.

Constituent Parts.	Vauquelin.	
Silica,	35 to	36
Alumina,	18	19
Glucina,	14	15
Iron,	2	3
Loss,	31	27
	100	100

Localities.—This mineral was brought from Peru, and has never been found any where else. It was in single crystals, so that its repository is unknown. It is by some mineralogists arranged among the ores of iron.

20. Species. Emerald.

Id. Kirw. i. 247. *L'Emeraude*, Brochant, i. 217. *Emeraude*, Hauy. ii. 516.

Essen. Char.—Scratches glass easily; divisible, parallel to the faces, and to the bases of a regular hexahedral prism.

Exter. Char.—The emerald is only found crystallized, and the primitive form of its crystals is a regular six-sided prism; the integrant molecule is a triangular prism, the sides square, and the bases equilateral triangles. The usual forms are, 1. A perfect six-sided prism; 2. Truncated on its lateral edges; 3. Truncated on its terminal edges; 4. Truncated on its terminal angles; and, 5. Having the terminal edges bevelled. The crystals are seldom large. Their surface is smooth and shining; internal lustre shining and resplendent; vitreous; fracture conchoidal or unequal, sometimes transversely foliated; fragments indeterminate, sharp edged.

Colour emerald green of all shades; most commonly transparent, sometimes only translucent: refraction double; with difficulty scratches quartz. Spec. grav. 2.600 to 2.775.

Chem. Char.—Fusible before the blow-pipe, but with difficulty; melts readily with borax.

Constituent Parts.

	Vauquelin.	Klaproth.
Silica,	64.50	68.50
Alumina,	16.	15.75
Glucina,	13.	12.50
Oxide of chromium,	3.25	.30
Lime,	1.60	.25
Oxide of iron,		1.
Water,	2.	
	100.35	98.3

Localities, &c.—The finest emeralds are brought from Peru, where they are found in veins or cavities of the granite mountains. They are also found in Upper Egypt, Ethiopia, and in the island of Ceylon. The emerald is accompanied by calcareous substances, as carbonate of lime and gypsum.

Uses.—The rich green of the emerald has obtained for it a high rank among precious stones, and it is employed for similar purposes.

21. Species. Beryl.

Aqua Marina et Samaragdus, Beryllus, Wallerius, i. 254. *Aigue Marine de Siberie*, Romé de Lisle, ii. 252. *Id.* De Born, i. 71. *Beryl*, Kirw. i. 248. *Le Beril Noble*, Brochant, i. 220. *Emeraude Limpide, vert-bleuatre, jaune-verdatre*, &c. Hauy, ii. 521.

Essen. Char.—The same as the emerald.

Exter. Char.—The beryl is sometimes found in rounded fragments, but most commonly crystallized, and the forms of its crystal are the same as the emerald. The lateral faces of the crystals are deeply striated.

The colours of the beryl are usually a pale or yellowish green; external lustre shining; internal resplendent, vitreous; longitudinal fracture conchoidal, or foliated. Cleavage fourfold. Fragments indeterminate and sharp-edged; often transparent, sometimes semi-transparent, and translucent. The latter variety is distinguished by transverse rents. Refraction in a slight degree double; nearly as hard as topaz; brittle; spec. grav. 2.65 to 2.75. Becomes electric by friction.

Chem. Char.—Before the blow-pipe it is fusible, but with difficulty, and yields a white, scarcely translucent glass.

Constituent Parts.

	Vauquelin.	Rose.
Silica,	68	69
Alumina,	15	14
Glucina,	14	14
Lime,	2	
Oxide of iron,	1	1
	100	98

Localities, &c.—The beryl is brought from the East Indies, and from Brazil; but the finest and purest are found in Daouria, on the frontiers of China, in the neighbourhood of Nertschinsk; and the matrix of these beryls is said to be an indurated clay, resembling jasper. The beryl is also found in Siberia, where it is usually accompanied with quartz, feldspar, garnets, tourmaline, mica, and fluor spar, in the veins of primitive mountains. The beryls from Siberia are almost all found in graphic granite. Beryl is also found in Saxony, and lately in France, in a large vein of quartz traversing graphic granite. Dolomieu found the beryl perfectly transparent and colourless, in the granite of the island of Elba.

Uses.—The beryl is employed as a precious stone, but is not greatly esteemed.

Remarks.—The emerald and the precious beryl approach so nearly to each other, not only in the forms of their crystals, which are almost the same, and in their constituent parts, which afford but slight variations, but also in their other characters, that they ought to be considered, as has been done by Hauy, as varieties of the same species. The only differences which exist between them seem to be accidental. These are chiefly in the colour, and in the crystallization; the former of which is a finer green, and the latter is more perfect in the emerald than in the beryl. The colouring matter of the emerald is oxide of chromium, while that of the beryl

Siliceous genus.

ryl is oxide of iron. In all the other characters they are nearly the same.

22. Species. SCHORLITE, or *Schorlous Beyrl.*

Schorlite, Kirw. i. 286. *Le Beril Schorliforme*, Brochant i. 224. *Leucolite* and *Pycnite*, Hauy, iii. 236.

Essen. Char.—Infusible. Original form of the crystals a regular hexahedral prism.

Exter. Char.—This mineral is usually found crystallized, in longish masses, mixed with other substances, and generally imbedded in granite; the form of the crystals, when they are regular, is a six-sided prism, which is sometimes truncated on its terminal edges, and sometimes the form disappears from its being deeply and longitudinally striated. The crystals are generally large.

Colour white, straw yellow, or reddish. Translucent or nearly opaque. External lustre shining between vitreous and resinous. Cross facture imperfectly foliated, longitudinal, imperfectly conchoidal. Scratches quartz slightly. Brittle. Spec. grav. 3.514 to 3.530.

Chem. Char.—Infusible with the blow-pipe; with borax yields a transparent glass.

Constituent Parts.

	Klaproth.	Vauquelin.	Vauquelin, another analysis.
Silica,	50	36.8	30
Alumina,	50	52.6	60
Lime,	—	3.3	2
Water,	—	1.5	1
Fluoric acid,	—	—	6
Loss,	—	5.8	1
	100	100	100

Localities, &c.—This mineral is generally found imbedded in granite; sometimes it is met with in gneis, accompanied with lepidolite. It enters into the composition of a rock formed of quartz and gray mica at Altenberg in Saxony. A red variety of this mineral was formerly considered by mineralogists as a crystallized lepidolite. Schorlous beryl has been arranged as a subspecies of beryl; but its specific gravity, different degree of hardness, and especially its composition, are characters sufficiently distinct to constitute a separate species.

23. Species. SCHORL.

This species is divided into two subspecies; 1. Black or common schorl, and 2. Tourmaline.

Subspecies 1. BLACK SCHORL.

Schorl, Kirw. i. 265. *Le Schorl Noir*, Brochant, i. 226. *Tourmaline*, Hauy, iii. 31.

Essen. Char.—Electric by heat in the two opposite extremities; forms of the crystals derived from a rhomboid.

Exter. Char.—This mineral is found in masses, and disseminated, but most frequently crystallized. The primitive form of its crystals is an obtuse rhomboid; the integrant molecule is a tetrahedron. Its usual forms are, 1. A three-sided prism, with the lateral edges either truncated or bevelled; 2. The same prism having a three-sided obtuse summit, the sides corresponding to the lateral edges. The truncations and bevelments of the lateral edges vary in the size of the faces, thus producing prisms of six and nine sides. The lateral faces of the three-sided prism are often convex. The lateral surfaces are longitudinally and deeply striated. The lustre, both external and internal, which is vitreous, varies between shining and weakly shining. The facture is imperfectly conchoidal or uneven; cross facture is sometimes convex on the one side and concave on the other. When black schorl is massive, it is found in separate pieces, thin, and apparently fibrous, parallel, or interwoven and divergent. The faces of these separate pieces are striated lengthwise. The fragments are indeterminate.

Classification.

Colour velvet black of various shades. Commonly opaque, rarely translucent, except in small crystals. Streak gray. Inferior to quartz in hardness. Specific gravity 3.092 to 3.212.

Chem. Char.—Under the blow-pipe it froths up, and melts into a grayish white enamel.

Constituent Parts. Wiegleb.

Alumina,	40.83
Silica,	33.33
Iron,	20.41
Manganese,	3.33

Physical Char.—Black schorl becomes electric by heat; and the electricity of one extremity of the crystal is positive, while that of the other is negative; but when it cools, it is said, that the nature of the electricity is reversed; the positive extremity becomes negative, and the negative becomes positive.

Localities, &c.—Black schorl is usually found in granite, gneis, and the other primitive rocks; in veins of tin and ores of iron; in the topaz rock of Schneeckenstein in Saxony, of which it constitutes a part. It is also met with in Switzerland, Spain, Hungary, and Britain.

Subspecies 2. TOURMALINE.

Id. Kirw. i. 271. *Le Schorl Electrique*, Brochant, i. 229. *Tourmaline Verte*, Hauy, iii. 41.

Essen. Char.—The same as black schorl.

Exter. Char.—The tourmaline is found sometimes in masses and grains, but most commonly crystallized. The form of its crystals is a regular three-sided prism, with the edges, 1. Either truncated or bevelled. 2. A regular three-sided prism with the lateral faces convex, and terminating in an obtuse, three-sided prism, the sides of which correspond to the lateral faces at one extremity, and to the lateral edges at the other. 3. An obtuse, double, three-sided pyramid, the faces of the one corresponding to the edges of the other. 4. A six-sided prism with equal angles. 5. A six-sided prism, the sides meeting two and two alternately under three obtuse angles. 6. A nine-sided prism, having three lateral angles acute, and six obtuse alternately. 7. The same crystal having the three acute lateral edges truncated, and thus forming a twelve-sided prism. The surface of the crystals is sometimes smooth, but most

Classification.

most frequently striated longitudinally. Lustre shining and vitreous. Longitudinal fracture conchoidal; cross fracture foliated. The direction of the plates is inclined to the axis of the prism. Fragments indeterminate; the crystals are usually opaque, when seen laterally.

The colour of the tourmaline is greenish, of various shades, yellowish brown, and very rarely indigo blue. The colours are usually very deep, and at first sight appear black. It is usually translucent, and sometimes approaching to transparent, particularly when it is seen in a direction perpendicular to the axis of the prism; but it appears opaque when it is seen in a direction perpendicular to the basis of the prism, even when the height of the prism is less than its thickness. It is harder than quartz. Brittle. Spec. grav. 3.086 to 3.363.

Chem. Char.—With the blow-pipe the tourmaline melts into a grayish white, porous enamel.

Constituent Parts.

	Bergman.	Vauquelin.
Silica,	37	40.
Alumina,	39	39.
Lime,	15	3.84
Oxide of iron,	9	12.50
——— manganese,		2.
	100	97.34

Bergman's analysis is of the tourmaline of Ceylon. Vauquelin's is that of the green tourmaline of Brazil.

Physical Char.—The property of the tourmaline, of becoming electric by heat, has been already noticed as one of its distinctive characters. This physical property has occupied the attention of philosophers for a long time. It was observed by Lemery in 1719, and examined by Epinus in 1770. Pliny indeed mentions a reddish or purple-coloured stone, which being heated or rubbed, attracts light bodies. This is supposed to have been the tourmaline. This property is susceptible of various modifications. The electricity of the tourmaline may be conveniently exhibited by heating two crystals, suspending the one by a thread, and presenting successively to its extremities the extremities of the other crystal. The extremities which possess the same kind of electricity will be repelled, while those which possess a different kind will be attracted. If a crystal of tourmaline be broken while it is electrified, the fragments immediately present electrical poles, situated in the same direction as those of the entire crystal.

The extremity of the crystals of tourmaline which has the greatest number of faces, exhibits positive electricity, while the extremity having the smaller number of faces exhibits negative electricity. The proper degree of heat for exciting the electricity of tourmaline is from 100° to the boiling point of Fahrenheit. When heated beyond this point, it is deprived of its electricity, and recovers it only in cooling; but if the temperature be increased still more, the crystal becomes again electric, but the poles are reversed. The electric poles may be also reversed, by heating a crystal of tourmaline unequally, by means of a burning glass.

Localities, &c.—The tourmaline is found in almost all primitive mountains; the finest crystals are brought from Ceylon, Madagascar, Saxony, the Tyrol, Spain, and Brazil. The tourmaline of the Tyrol is found in a talcky rock, mixed with chlorite, mica, and hornblende. Those of Saxony and Spain are found imbedded in gneis, but those of Brazil and Ceylon are in separate crystals. In Bohemia they are found in mines. The tourmaline is also a native of France, Sweden, Norway, and Britain.

Siliceous genus.

24. Species. PISTAZITE.

Glassy actynolite, Kirwan, i. 168. *Delphinite*, Saussure Voyages, N° 1918. *Acanticone*, *Arendalite*, D'Andrada, Nich. Jour. 4to. v. 193. *La Rayonnante Vitreuse*, Brochant, i. 310. *Epidote*, Hauy, iii. 102.

Essen. Char.—Divisible parallel to the faces of a rhomboidal prism of $114\frac{1}{2}°$, and $65\frac{1}{2}°$.

Exter. Char.—Pistazite is found massive or crystallized in flattened four-sided prisms, terminated by four-sided pyramids, and also sometimes in regular six-sided prisms; the summit of the pyramid almost always truncated, as well as the lateral edges. The crystals are sometimes acicular and streaked longitudinally. Internal lustre shining. Fracture foliated or radiated. Fragments wedge-shaped and splintery.

Colour deep green, olive green, or greenish yellow. Translucent, sometimes transparent. Hard, easily scratches glass, and is brittle. Spec. grav. 3.45. Powder greenish yellow or whitish.

Chem Char.—Fusible by the blow-pipe, and is converted into a brown slag, which blackens by continuing the heat.

Constituent Parts.

	Vauquelin.	Descotils.
Silica,	37	37
Alumina,	21	27
Lime,	15	14
Oxide of iron,	24	17
——— manganese,	1.5	1.5
Loss,	1.5	3.5
	100.0	100.0

Localities, &c.—Pistazite is found in Dauphiny, on the surface and in the fissures of an argillaceous rock, accompanied by quartz, amianthus, and feldspar, and in the Pyrenees in limestone; near Arendal in Norway; and in argillaceous schistus, north end of the island of Arran in Scotland.

25. Species. ZOYSITE.

This mineral, which was discovered by Baron de Zoys, and therefore bears his name, is considered by Hauy as a variety of Epidote.

It appears in prisms which are deeply furrowed or rhomboidal, and very much flattened. They are of a gray colour, or grayish yellow, with a pearly lustre.

Localities.—Zoysite is found particularly in Carinthia, and also in the Tyrol and in the Valais*.

* Brongniart, ii. 40.

26. Species. AXINITE, or THUMERSTONE.

Id. Kirw. i. 273. *La Pierre de Thum*, Brochant, i. 236. *Axinite*, Hauy, iii. 22.

Essen. Char.—Divisible parallel to the faces of a rhomboidal prism of $101\frac{1}{2}°$, and $78\frac{1}{2}°$.

Siliceous genus.

Exter. Char.—Thumerstone is found in masses, disseminated and crystallized. The primitive form of its crystals is a right-angled prism, whose bases are oblique-angled parallelograms, having their angles of 101° 32′, and 78° 28′. The integrant molecule is an oblique triangular prism. The most common form of its crystals is a quadrangular prism, so oblique and flattened, that its angles become as sharp as the cutting part of a hatchet. The faces of the crystals are longitudinally striated, but the truncated faces are smooth. Externally lustre splendent; internal shining and vitreous. Fracture vitreous, sometimes rough and splintery. Fragments indeterminate, sharp edged. Massive thumerstone is composed of separate testaceous, thin, and slightly curved concretions, with a smooth surface, which is somewhat irregularly striated.

The colour is clove brown, varying to violet blue, yellowish, and greenish gray. Massive thumerstone is only translucent. The crystals are semitransparent, and sometimes transparent. It is harder than feldspar, but less so than quartz; gives fire with steel, and diffuses an odour similar to what is produced by flint. Brittle. Spec. grav. 3.213 to 3.300.

Chem. Char.—Thumerstone froths up under the blow-pipe, and is converted into a grayish enamel, and with borax into a fine olive green enamel.

Constituent Parts.

	Klaproth.	Vauquelin.
Silica,	52.70	44
Alumina,	25.79	18
Lime,	9.39	19
Oxide of iron,	8.63	14
———manganese,	1.	4
Loss,	2.49	1
	100.00	100

Localities, &c.—Thumerstone, which is hitherto a rare mineral, has been only found in veins and fissures of primitive rocks, and chiefly in rocks with a base of serpentine. It is usually accompanied with asbestus, rock crystal, and sometimes calcareous spar. It was first discovered at Thum in Saxony, from which it derives its name; but has been since found in the Pyrenees, in France, at Mount Atlas in Africa, in Norway, and in Cornwall in Britain.

27. Species. Quartz.

Essen. Char.—Divisible into a rhomboid, which is slightly obtuse.

Quartz, which is found, either massive, crystallized, or in rounded pieces, is one of the most abundant mineral substances. The primitive form of its crystals is a slightly obtuse rhomboid, of 94° 4′, and 85° 56′. The integrant molecule is a regular tetrahedron.

On account of the variety of forms and appearances, quartz has been divided into subspecies; into five by Werner; by others only into two, viz. rock-crystal and common quartz. We shall nearly follow the former subdivisions, which are, amethyst, rock-crystal, milk-quartz, common quartz, and prase, including also ferruginous quartz.

Subspecies 1. Amethyst,

Id. Kirw. i. 264. *L'Amethyste, Quartz-hyalin Violet*, Hauy, ii. 417.

Classification.

Exter. Char.—The amethyst is found frequently crystallized, but it is also found massive and in rounded pieces. 1. The form of its crystals is a regular six-sided prism, terminated by a six-sided pyramid, the sides of which correspond to those of the prism. 2. A double six-sided pyramid. Fracture conchoidal, rarely splintery or fibrous. Fragments indeterminate, sometimes wedge-shaped. Massive amethyst is composed of separate pieces, which are sometimes granulated, sometimes scopiform when the crystals are combined together.

The colour is commonly violet blue of various shades, blackish brown and greenish white. External lustre resplendent; internal resplendent and shining vitreous. It varies between transparent and translucent. Scratches glass. Brittle. Spec. grav. 2.653 to 2.750.

Chem. Char.—Entirely infusible under the action of the blow-pipe.

Constituent Parts. Rose.

Silica,	97.50
Alumina,	.25
Oxide of iron and manganese,	.50
	98.25

Localities, &c.—Amethyst is found in Bohemia, Saxony, Siberia, very abundant in the Uralian mountains, Hungary, and Auvergne in France. It is usually met with in the veins of metalliferous mountains, very rarely in granitic mountains. It is frequently met with crystallized, lining the cavities of balls of agate; in amygdaloid and porphyry rocks.

Uses.—When the amethyst is cut and polished, it assumes an agreeable colour and lustre, so that it is employed in jewellery.

Werner has divided the amethyst into two varieties, the common and fibrous; the latter being chiefly characterized by its fibrous fracture and resinous lustre. This latter variety too, is only found massive.

Subspecies 2. Rock Crystal.

Mountain Crystal, Kirw. i. 241. *Le Cristal de roche*, Brochant. i. 243. *Quartz-hyalin Limpide*, Hauy, ii. 417.

Exter. Char.—Rock crystal is usually found crystallized, sometimes in rounded pieces, but rarely massive. The form of its crystals is, 1. A six-sided prism, having one of its bases or both surmounted by a sharp pointed pyramid; the sides of the pyramid and prism corresponding. This is its most usual form; but it exhibits many apparent varieties, arising from modifications in the magnitude of one or several of the faces at the expence of the others, 2. A double six-sided pyramid, which is sometimes perfect, and sometimes truncated on the edges of the common base; and sometimes too, three alternating faces on each pyramid are larger than the others, giving to the crystal the appearance of a cube. 3. A simple, very acute pyramid with six sides, having its summit, and often also its base, acuminated with six faces: but this is rather an irregularity in the crystallization than a new form.

The crystals of this mineral are sometimes very large, and they are also found very small. In the rounded pieces the external surface is rough, but in the perfect crystals

Classification.

crystals the faces of the prism are striated transversely; but those of the pyramids and acuminations are smooth. The lustre is resplendent and vitreous; fracture perfectly conchoidal, sometimes, however, foliated; fragments indeterminate, very sharp edged.

Colours of rock-crystals are grayish white, yellowish white, pearl gray, yellowish and blackish brown. Internally it is sometimes iridescent. It is transparent, sometimes semitransparent. By looking across one of the faces of the pyramid, and the opposite face of the prism, double refraction is produced. Scratches glass, and gives sparks with steel. Somewhat frangible; spec. grav. 2.650 to 2.888.

Chem. Char.—Entirely infusible before the blow-pipe.

Constituent Parts.	Bergman.
Silica,	93
Alumina,	6
Lime,	1
	100

Physical Char.—It is sometimes phosphorescent; two crystals, by being rubbed together, exhibit a little light in the dark, and give out a peculiar odour, which is somewhat empyreumatic.

Localities, &c.—Rock-crystal is most commonly found in veins of primitive rocks, and particularly in granite; in druses lining the cavities of these rocks. The finest crystals are now brought from Madagascar, but it is a very frequent mineral in most countries, as in the mountains of Switzerland, where it was formerly dug out of the faces of lofty precipices by the inhabitants. It is also found in Bohemia, Saxony, Hungary, and in Cornwall in England, and different parts of Scotland, as in the island of Arran, in the cavities of the granite mountains, and in Cairngorm in Aberdeenshire, the two latter, which are well known by the name of Arran stones and Cairngorms, are usually of a smoky colour, owing, it is supposed, to iron or manganese; probably to the latter, for from some experiments which we have made, the colour entirely disappears by exposing the crystal to a strong heat, and from other observations it appears that the colouring matter is also destroyed by the action of light.

Rock crystal sometimes contains schorl, amianthus, actynolite, mica, and titanium. Crystals are also sometimes met with in cavities containing a drop of water, and a small quantity of air.

Uses.—Rock crystal, on account of its lustre and transparency, is employed in jewellery, and particularly when it is coloured, as those from Cairngorm in the north of Scotland, many of which are held in high estimation.

Subspecies 3. Rosy Red or Milky Quartz.

Rosy Red Quartz, Kirw. i. 245. *Quartz, laiteux*, Brochant, i. 246. *Quartz-hyalin laiteux*, Hauy, ii. 420.

Exter. Char.—This mineral is always found massive. It is indeed said by Emmerling, that it has been found crystallized, in small six-sided prisms, terminated by a six sided pyramid, at Rabenstein in Bavaria. Internally, its lustre is shining, rarely resplendent; resinous; fracture perfectly conchoidal, and fragments indeterminate. It varies between semitransparent and translucent. Siliceous genus.

The colour is sometimes milk white; but its principal colour, it is said, is pale rose red. In its other characters it agrees with rock crystal.

It is suspected that this mineral is composed of silica and oxide of manganese, to the latter of which the colour is owing.

Localities, &c.—Milk quartz forms beds in primitive mountains; at Rabenstein in Bavaria it is met with in a large grained granite. It is also found in Finland, Greenland, Saxony, Siberia, and the western part of Inverness-shire in Scotland.

Uses.—The semitransparence, the fine colour, and the polish of which it is susceptible, have introduced this mineral to be employed in jewellery.

Subspecies 4. Common Quartz.

Quartz, Kirw. i. 242. *Le Quartz commune*, Brochant, i. 248. *Quartz hyalin amorphe*, Hauy, ii. 425.

Exter. Char.—Common quartz is found in various forms, massive, disseminated, in grains, and rounded pieces. It is sometimes stalactitical, globular, kidney-form, tuberculated, cellular, perforated, and corroded; sometimes also it is crystallized, and the crystals are either true or supposititious. The true crystals are grouped together in reniform, rounded, or radiated masses; the form is the same as that of rock crystal. The pseudo crystals derive their figure from the substances on which they are formed, as the cube from fluor spar, the octahedron from the same, the six-sided table from barytes, the acute six-sided pyramid from calcareous spar. The surface of the true crystals is similar to that of rock crystal, but that of the pseudo crystals is rough, and the lustre is dull. Fracture of common quartz is small, conchoidal; sometimes large, splintery, and sometimes imperfectly foliated, or fibrous, with large parallel fibres. Fragments indeterminate, with sharp edges, very rarely rhomboidal. It is commonly translucent, rarely semitransparent. The colour is milk white, snow white, reddish white, and blood and flesh red, with many shades of these colours. Scratches glass. Spec. grav. 2.640 to 2.654.

Chem. Char.—Infusible before the blow-pipe. Silica forms the principal constituent part; but among the numerous varieties of common quartz, there are no doubt slight differences in the nature and quantity of the materials which enter into its composition. The different shades of colour are owing to different portions and different states of metallic substances.

Localities, &c.—Common quartz is one of the substances of most frequent occurrence in all kinds of rocks, forming one of the chief component parts of primitive mountains, sometimes in entire beds, or whole mountains, as in the islands of Isla and Jura in Scotland. It is also frequent in veins, very common in stratiform rocks, where it constitutes the base of sandstone: in alluvial rocks it is met with in rounded pieces, or in the form of sand.

Uses.—Common quartz is employed in the manufacture of glass instead of sand; in the fabrication of smalt, and as a flux for calcareous ores of iron.

A variety of this, called aventurine, is sometimes held in considerable estimation. It is the quartz hyalin aventurine

Siliceous genus.

aventuriné of Hauy, and the natural aventuriné of De Lisle. It is of a deep red, gray, green, or blackish colour, marked with spots sometimes of a yellowish, and sometimes of a silvery appearance, which proceed from very thin pieces of pure quartz disseminated in the mass. It ought not to be confounded with quartz mixed with mica, or micaceous quartz, which is a compound rock. On the contrary, the diversity of colours seems to be owing to numerous fissures which are arranged nearly in the same direction.

Aventurine is found near Vasles, in the department of Deux Sevres in France, in the form of rounded stones, which are reddish; at Cape de Gates in Spain, of a whitish colour, with silvery spots; in Arragon, which affords several varieties; near Madrid, among rounded fragments of granite; at Facebay in Transylvania, where it is of a black colour, with very small golden spots; and in the neighbourhood of Catharineburg in Siberia.

The name aventurine is derived from the following circumstance. A workman having dropped by chance, *par aventure*, some brass filings into a vitreous matter in the state of fusion, gave the mixture this name, of which was afterwards made vases and other ornamental objects. Mineralogists gave the same name to natural substances which have a striking resemblance to this artificial production. Hauy, ii. 422.

Subspecies 5. Prase.

Prasium, Kirw. i. 249. *La Prase*, Brochant, i. 252. *Quartz Hyalin Vert obscure*, ii. 419. *Quartz Prase*, Brongniart, i. 280.

Exter. Char.—This mineral possesses all the characters of quartz in general. It is most commonly found massive, and very rarely crystallized. The crystals, which are usually small, have the form of rock crystal.

The colour is usually leek green; the external surface is rough and glistening; the internal shining and vitreous; it is translucent; the fracture imperfectly conchoidal, and sometimes coarse splintery; fragments sharp-edged. When it is massive, it is composed of distinct concretions, which are granulated prismatic, or cuneiform, the surface of which is rough and transversely striated.

Localities, &c.—Prase is found at Brietenbrunn near Schwartzenberg in Saxony, in a metallic vein, accompanied with magnetic pyrites, galena, blende, calcareous spar, and actynolite. It is also found in Bohemia, in Finland, near lake Onega, and in Siberia.

Uses.—As it is susceptible of a fine polish, prase is employed in jewellery.

This mineral ought not to be confounded with quartz coloured by means of chlorite, which latter is of a brighter green, but opaque.

Subspecies 6. Ferruginous Quartz, or *Iron Flint*.

Le Caillou Ferrugineux, Brochant, i. 248. *Quartz Rubigineux*, Brongniart, i. 281. *Quartz Hyalin hematoide*, Hauy, ii. 420. *Eisenkiesel* of the Germans.

Exter. Char.—The peculiar character of this mineral seems to be owing to a large proportion of oxide of iron, which renders it opaque. It is usually found massive, but it sometimes also assumes a crystalline form, which is a prism with six equal sides, acuminated at each extremity with three planes. The colour is of a yellowish brown, sometimes of a brownish red, and of a bright blood red. It is usually opaque, or only transparent at the edges. External lustre resplendent; internal shining and vitreous. Fracture imperfectly conchoidal; fragments angular, but not very sharp-edged. Concretions small grained and distinct. It is harder than common jasper. Not very brittle. Classification.

Localities.—This mineral is found in veins of ironstone in Saxony, and in England, where it is accompanied with sulphate of barytes.

Ferruginous quartz is distinguished from jasper, to the red variety of which it has a striking resemblance, by its shining fracture, which is also vitreous and conchoidal; its property of crystallizing; and according to Brongniart, by having no alumina in its composition, which he properly considers as an essential characteristic.

28. Species. Hornstone.

Hornstone, Kirw. i. 303. *La Pierre de Corne*, Brochant, i. 254. *Petrosilex*, Hauy, iv. 385.

This mineral is met with in masses and also in rounded balls. The colour is usually gray; it is translucent at the edges, the fracture splintery or conchoidal; it has little lustre; is so hard as to scratch glass, and give fire with steel; and its spec. grav. is from 2.699 to 2.708.

The diversity of fracture which has been observed in hornstone, has led to the subdivision of this species into three subspecies, viz. splintery hornstone, conchoidal hornstone, and woodstone.

Subspecies 1. Splintery Hornstone.

Hornstone Ecailleux, Brochant, i. 255. *Petrosilex Squamosus*, Wallerius, i. 280.

Exter. Char.—This mineral is found massive, or in rounded pieces. It has scarcely any lustre; the fracture is fine, splintery; fragments sharp edged; translucent at the edges. It is scarcely so hard as quartz; it is brittle.

The colour is bluish gray, smoke and pearl gray, sometimes greenish and yellowish gray, more rarely olive and mountain green. Sometimes there is a mixture of these colours, arranged in spots and stripes. Spec. grav. 2.654. Kirw.

Chem. Char.—According to some mineralogists, this variety of hornstone is fusible before the blow-pipe, but according to others it is infusible without the addition of borax.

The following are the constituent parts of a hornstone analyzed by Kirwan.

Silica,	72
Alumina,	22
Carbonate of Lime,	6
	100

Localities, &c.—This variety of hornstone is chiefly found in veins in primitive mountains. It is also found in rounded pieces in alluvial rocks, and it constitutes the chief basis of hornstone porphyry, as at Dannemora and Garpenberg in Sweden. It is met with in veins at Freyberg, Schneeberg, Johann-Georgenstadt, and Gersdorf in Saxony.

Subspecies

Classification.

Subspecies 2. Conchoidal Hornstone.

Petrosilex Equabilis, Wallerius, i. 281. *Le Hornstein Conchoide*, Brochant, i. 258.

Exter. Char.—This mineral is always found massive, and seems to approach in its characters very nearly to the preceding variety or subspecies, excepting in the fracture, which is perfectly conchoidal.

Localities, &c.—This subspecies is found in beds and veins, when it is sometimes accompanied with agate. It has been found accompanying gneis at Goldberg in Saxony, and fine specimens of both subspecies are met with in the island of Rona near Sky in Scotland, where it seems to form a considerable vein, traversing a gneis rock.

Subspecies 3. Woodstone, or *Petrified Wood.*

Woodstone, Kirw. i. 215. *Le Holzstein*, Brochant, i. 259. *Quartz Agathe Hyloide*, Hauy, ii. 439.

This subspecies possesses more distinctive characters than the former; and as it seems to be wood, retaining its original texture, converted into hornstone by some petrifying process, it is usually found in insulated masses, or in rounded pieces. It has the external appearance of wood, for the surface is rough and uneven, or longitudinally striated; internally it is glistening, but sometimes dull, having a vitreous lustre. The fracture most frequently exhibits the fibrous texture of the wood. The cross fracture is sometimes splintery or imperfectly conchoidal. The fragments are indeterminate, and slightly sharp-edged. The most common colour is dark gray, ash gray, grayish white, and sometimes cochineal and blood red. Different colours appear in the same mineral, forming spots, clouds, or stripes. It is commonly translucent at the edges, sometimes entirely translucent, and sometimes opaque. It is hard and brittle.

Localities.—Woodstone is met with in Bohemia, Saxony, and Siberia, and on the banks of Loch Neagh in the north of Ireland, particularly, as we have been informed, near places where some of the rivers discharge their waters into the lake.

Uses.—This mineral is generally susceptible of a fine polish, and is therefore employed in jewellery.

29. Species. Flinty Slate, or *Siliceous Schistus.*

This species is divided into two subspecies or varieties, viz. common siliceous schistus, and Lydian stone.

Subspecies 1. Common Siliceous Schistus.

Siliceous schistus, Kirw. i. 306. *Schiste silicicux commun*, Brochant, i. 283.

Exter. Char.—This mineral is found in masses or rounded pieces, and it is frequently transversed by veins of quartz of a grayish white, or coloured red by means of iron. This, it is said, is a distinguishing characteristic of siliceous schistus which it rarely wants (Brochant). Internally it is dull, very rarely a little glimmering. The fracture in the small is compact, sometimes splintery, and sometimes imperfectly conchoidal; but in the great or large masses it is slaty, a character which almost always disappears in the small fragments. The fragments are sharp edged. The colour is blackish, greenish, or smoke gray. It is commonly opaque, rarely translucent at the edges. It is hard and brittle.

Siliceous genus.

Chem. Char.—Before the blow-pipe, gray siliceous schistus becomes white and friable; the black assumes a darker colour, and is a little vitrified at the edges.

Constituent Parts.	Wiegleb.
Silica,	75
Magnesia,	4.58
Lime,	10.
Iron,	3.54
Inflammable matters,	5.02
Loss,	1.86
	100.00

Localities, &c.—Siliceous schistus is met with in Bohemia, Saxony, Switzerland, and Siberia; at Leadhills in Scotland, and also at Carlops near the termination of the great coal field to the south of Edinburgh.

The geological position of this stone is not precisely determined. In Scotland it is connected with those rocks which come under the denomination of transition rocks; but according to different descriptions it seems to have been confounded with argillaceous schistus, with which indeed it possesses some common properties; and some mineralogists regard it as an argillaceous schistus, having a larger proportion of siliceous earth. In support of this opinion, siliceous schistus has been found in situations where it is subordinate to argillaceous schistus.

Subspecies 2. Lydian Stone.

Basanite, Kirw. i. 307. *La Pierre de Lydie*, Brochant, i. 286. *Roche Cornenne*, Hauy, iv. 434.

This stone, which is of a grayish, bluish, or velvet black, is found in masses, and in rounded pieces of a trapezoidal form, which are also traversed with veins of whitish quartz. The external surface is smooth and weakly shining; the internal is glimmering. The fracture is even, sometimes slightly conchoidal or uneven, rarely splintery; in large masses it is slaty. The fragments are sharp-edged, and sometimes assume a cubical form. It is commonly opaque, and rarely translucent at the edges. It is scratched by quartz; brittle. Spec. grav. 2.415 to 2.880.

Localities.—Lydian stone is found in similar places with the former variety.

Uses.—This stone has been long known under the name of *touchstone*, because it is employed to ascertain the purity of gold. From this use it obtained the name of βασανος or the *trier*, and it was called Lydian stone, because it was found in Lydia. When it is employed as a touchstone, the gold to be tried is rubbed on its polished surface; on the metallic trace which remains nitric acid is poured, and the quantity of alloy is judged of by the degree of change which takes place, this being compared with traces made and treated in the same way with needles differently alloyed and prepared for the purpose. This test, it is to be observed, is not perfectly accurate, but is sufficiently so for those who are much employed in the use of it. The property which renders this mineral fit for the above purpose depends on its degree of hardness, while it presents at the same time a smooth and even fracture without being perfectly smooth. Other stones possessing similar properties,

Siliceous genus.

ties, such as several varieties of basalt, are conveniently employed for the same purpose.

30. Species. Flint.

Flint, Kirw. i. 301. *Pierre à fusil*, Brochant, i. 263. *Quartz-Agathe Pyromaque*, Hauy, ii. 427.

Exter. Char.—Flint is found massive, disseminated, in angular fragments, in globular masses, tuberculated, and perforated. The surface is sometimes rough, sometimes uneven, and sometimes smooth. The white crust with which it is often covered, is considered by some mineralogists as an incipient decomposition. The external lustre is dull or a little glimmering; the internal is weakly shining; the fracture is perfectly conchoidal, the fragments sharp edged. The colour is usually gray, smoke gray, sometimes perfectly black. Various colours appear in the same mineral, presenting spots, stripes, and clouds. Commonly translucent at the edges; scratches quartz: spec. grav. 2.58 to 2.99.

Chem. Char.—Entirely infusible before the blowpipe.

Constituent Parts.

	Klaproth.	Vauquelin.
Silica,	98.	97
Lime,	.50	
Alumina,	.25 }	1
Oxide of iron,	.25 }	
	99.00	98

Physical Char.—Two pieces of flint rubbed together in the dark, give out, like quartz, a phosphoric light.

Localities, &c.—Flint is never found in primitive mountains, excepting in very small quantity, and very rarely, in some veins; in alluvial rocks it is sometimes met with in rounded pieces; but it is most abundant in stratified mountains, particularly in beds of limestone, marl and chalk, in which it is disposed in parallel layers. It is met with in Saxony, Denmark, Sweden, Poland, and Spain, and is very abundant in chalk beds in the north of France, and also in different parts of England. It is also met with distributed in layers in the white limestone rocks, on the north coast of Ireland. In the department of Jura in France, globular masses of flint have been found with cavities containing sulphur.

The singular geological relations of this mineral have greatly puzzled naturalists, who are fond of such speculations, and are never satisfied till they have accounted for every thing, however scanty and defective the data may be on which their hypotheses are formed. It is on this account that the theories which have been proposed, to explain the formation of flint, offer nothing more than the silliest and most groundless conjectures; and indeed the same remark is equally applicable to theories of the earth in general. It has been already observed that flint is regularly disposed in layers, in the beds of chalk or limestone in which it is found. In an insulated mass of white limestone near Port Rush on the north coast of Ireland, which we had an opportunity of examining, the balls of flint were disposed in this way with great regularity. When the bed of limestone is of no great thickness, it contains only one layer of flints, but in thicker beds there are two layers of flints, the one near the top, and the other near the bottom of the bed. Those layers of flint, too, it is to be observed, have exactly the same inclination as the strata of limestone. According to one set of theorists, the flint being in a state of fusion, was ejected from the bowels of the earth, and deposited in the places where it is now found. This opinion carries along with it its own absurdity; for admitting that the flinty matter has been in a state of fusion, it is impossible to suppose that it could be deposited with so much uniformity and regularity, by being projected according to the conjecture of the philosophers who maintain this opinion. Had this been the mode of its formation, masses of flint would have been found throughout every part of the chalk or limestone beds, and not in regular layers, as is really the case.

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19 Formation of flints,

20 by fire,

According to another opinion, by which the formation of flint is proposed to be accounted for, cavities were produced, while the chalk and limestone were yet in a soft state, in consequence of the air extricated during the evaporation of the water; and the flinty matter in solution was introduced into these cavities by infiltration from above. But the same argument is equally forcible against this opinion. It is impossible to conceive that the cavities could be so regularly and uniformly produced by the extrication of the air. They would have been found through every part of the beds of chalk and limestone where flint is met with. And besides, even allowing that this flinty matter was held in solution by water, it might naturally be asked, why the greatest proportion of it was not deposited near the surface, when it first came in contact with the chalk or limestone, rather than to have continued to pass through the different beds, and form masses of solid flints at the greatest depths, in as great quantity as near the surface.

21 by water,

A third opinion, which some imagine to be less improbable than either of the former, supposes that flints have been entirely produced by marine animals deposited during the formation of the strata in which they are contained. This opinion seems to derive some support from the remains of marine animals, which are not unfrequently found included in nodules of flint. It is no rare occurrence to meet with shells thus attached to these nodules, and converted into flinty matter, but at the same time retaining their original form and appearance in the most perfect manner.

22 by marine animals.

Uses.—The extensive use of this mineral, in consequence of its property of striking fire with steel, as gun flints, is well known. Flints are employed also as a substitute for quartz in the manufacture of glass and porcelain, and in the fabrication of smalt. The coarser kinds, or such as are perforated and carious, are applied to the purposes of building and millstones. Sometimes the colours and the polish of flint are so fine as to have brought it into use in jewellery.

23 Manufacture of gun flints.

As flints are found in greatest abundance in France and England, the principal manufactures of gun flints are carried on in these countries. A particular account of this manufacture in France has been given by Dolomieu and Salivet, *Jour. des Mines*, N° 33, pp. 693 and 713. The whole process, which according to the description of Dolomieu is divided into four stages, is very simple.

1. After having fixed upon a mass of stone fit for

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for the purpose, the first part of the operation is to break the stone into pieces of convenient size. With this view the workman, seated on the ground, places the stone on his left thigh, and strikes it with small strokes, to divide it into pieces of a pound or a pound and a half weight, having large surfaces and smooth fractures, and at the same time he avoids splitting or shaking the stone by too feeble or too violent strokes.

2. In the next part of the operation the nicest management and dexterity of hand are required; for by repeated strokes splinters of the proper size to form gun flints are detached; one is separated at every stroke. During this operation he holds the mass of stone in his left hand. The splinters are about $1\frac{1}{2}$ inch broad, $2\frac{1}{2}$ long, and two lines thick in the middle. They are slightly convex above, and concave below; thick at one edge, and thin at the opposite edge.

3. The flint is brought to a regular shape during this part of the operation; and,

4. The edge of the gun flint which strikes fire, is brought to a straight line by placing it on a sharp iron instrument, and giving it five or six small strokes with a circular hammer (roulette). This finishes the operation, and the whole time of making a flint is not equal to a minute. With masses of stone that work easily, an expert workman will prepare 1000 good splinters in a day. It requires another day to bring to the proper shape 500; so that in three days he can split off from the mass and completely finish 1000 gun flints.

31. Species. CALCEDONY.

This species has been divided into two subspecies or varieties; common calcedony and carnelian.

Subspecies 1. Common CALCEDONY.

Id. Kirw. i. 298. *La Calcedoine Commune*, Brochant, i. 268. *Quartz Agathe Calcedoine*, Hauy, ii. 425.

Exter Char.—This mineral is found massive, in rounded pieces, which are globular, reniform, botryoidal, stalactitical, cellular; and sometimes also it is crystallized in the form of a cube, rhomboid, a simple pyramid with three and six faces; but these are supposed to be pseudo crystals, or merely a crust of calcedony on the crystals of other substances. The external surface is most commonly uneven, sometimes rough, and rarely smooth. External lustre is accidental; internal glimmering, rarely a little shining; fracture even, sometimes imperfectly conchoidal or splintery; fragments sharp edged.

Colour white, grayish or bluish white, yellowish or blackish: various colours appear in spots, clouds, stripes, and veins. Sometimes when it is cut it is iridescent; commonly transluscent, rarely semitransparent. Harder than flint. Brittle. Spec. grav. 2.600 to 2.700.

Chem. Char.—Before the blow-pipe it is infusible.

Constituent Parts.

	Bergman.
Silica,	84
Alumina,	16
A trace of iron,	—
	100

Localities, &c.—Calcedony is most usually met with in globular masses in amygdaloid, as at Oberstein, in the duchy of Deux Ponts. It is found also in Saxony, Silesia, and Siberia, in Iceland and the Faro islands; in the north of Ireland; and in several of the western islands of Scotland. The cavities of the balls of calcedony are often lined with crystals of quartz and amethyst. Siliceous genus.

Uses.—Calcedony takes a fine polish, and is therefore employed in jewellery.

2. Subspecies. CARNELIAN.

Id. Kirw. i. 300. *La Cornaline*, Brochant, i. 272. *Quartz-Agathe Cornaline*, Hauy, ii. 425.

This mineral is found in masses, or disseminated, but most frequently in rounded pieces of a globular, kidney form, or stalactitical shape. External surface rough and uneven; internal lustre glimmering, or slightly shining; fracture perfectly conchoidal; fragments very sharp-edged; most common colour blood red of various shades, and sometimes reddish brown or wax and honey yellow; semitransparent, hard, and brittle. Spec. grav. 2.59 to 2.73.

Chem. Char.—Carnelian is infusible before the blow-pipe, but loses its colour, and becomes white.

Localities, &c.—Carnelian is found in similar circumstances, and in similar places with common calcedony, but is of less frequent occurrence. The finest carnelians are brought from the east, and thence they are denominated oriental.

Uses.—The carnelian is employed for the same purposes as common calcedony.

Observations on Agate.—As common calcedony and carnelian, along with jasper, constitute the base of the greater number of agates, it may be here proper to introduce a few remarks on the mineral substances which are included under this name, and on the theories of their formation.

24 Varieties of agate.

The term agate is of very general application, comprehending numerous varieties, which are chiefly distinguished by the arrangement and disposition of the colours with which they are marked, and from which they have derived particular names. The following are some of the principal varieties of agate. 1. *Fortification* agate, in which the different coloured stripes are arranged in a zigzag manner, presenting something of the appearance of a fortified town. 2. *Landscape* agate, in which the colours and shades are so arranged as to exhibit the appearance of a landscape. 3. *Band* or *ribbon* agate, in which the various colours are disposed in stripes or zones, which are usually in straight lines, but sometimes concentric. To this variety of agate, when the zones or stripes are arranged parallel to each other, and distinctly marked, the name of onyx was given by the ancients. The name *onyx*, which signifies the nail of the finger, is derived from the whitish colour resembling that part of the body. They also gave the name of *sarde* to a variety of the same stone, of a flesh colour, and afterwards the compound name *sardonyx* was given to another variety, in which a whitish layer of the onyx, having some degree of transparency, covered another layer of a flesh red, the colour of which latter appeared through the former in the same manner as the colour of the flesh appears through the nail. But

Siliceous genus

in the end, the name of onyx seems to have been applied to all stones formed of layers of different colours.

4. *Moss* agate. In some varieties of agate filaments of a greenish or other colour, having the appearance of some species of confervæ or musci, are observed, and these have been denominated *moss agates*. Some have supposed that these filaments have been real mosses or confervæ, enveloped by the siliceous matter. In some also delineations of a brown or black colour, exhibit the appearance of trees or shrubs. This dendritical appearance is ascribed by some to the infiltration of iron or manganese into the natural fissures of the stone. The finest agates of this variety, it is said, are brought from Arabia, by the way of Mocha, on the coast of the Red sea; and hence they are known by the name of *Mocha stones*. Besides these varieties, there are several others, as *tubular* agate, when it is composed of calcedony, which seems to have been in the form of stalactites, and afterwards filled up with a different mineral substance, or at least of a different colour; *clouded* agate, presenting the appearance of clouds; *radiated* or *stellated*, when the different colours are arranged in rays; *breccia agate*, composed of fragments of different kinds of agate, and cemented together by siliceous matter, and constituting a real breccia; *spotted agate*, when the colours are disposed in points or spots; *petrified agate*, which seems to have been wood penetrated with the matter of agate; *coral agate*, having the appearance of coralloid; *jasper agate*, in which the predominant part of its composition is jasper.

25 Formation of agate,

The formation of agate has been the subject of much controversy among contending theorists; for while one party conceives that it affords the strongest proofs of being produced by means of heat, or from a state of fusion, another party seems to be equally convinced that it supplies them with the most certain evidence of having been formed from an aqueous solution.

26 by fusion,

Besides other strong objections that might be urged against the opinion of agate being formed from a state of fusion, the uniformity and regularity in the arrangement of the different kinds of matter of which it is composed, seem quite hostile to it, and, excepting to those who are previously prepossessed with such an opinion, will, we presume, appear altogether insurmountable; for it is inconceivable, that a mass of melted matter, whether it have been in a state of fusion in the place where it is now found, or projected from the bowels of the earth into the strata which are now its repository, while in a soft state, could arrange itself into layers, some of them often extremely thin, and disposed in stripes, concentric circles, spots, while these various kinds of matter exhibit very slight shades of difference in their constituent parts. It cannot even be imagined that all this could have been effected, even by the slowest and most gradual process of cooling.

27 by aqueous infiltration.

In accounting for the formation of agate by solution in water, it is said that the cavities in the rocks which contain agate, were formed in consequence of the evolution and extrication of air, while those rocks were in a state of softness; and that the matter of which agate is composed, was introduced in the state of an aqueous solution by means of infiltration. But objections, equally insurmountable, might easily be adduced against this theory: and one of the first that presents itself is derived from the diversity of matter deposited in masses of agate. This objection, indeed, is attempted to be obviated by supposing that the agate composed of different kinds of matter was derived from different kinds of successive solutions: but this is only removing the difficulty a step farther; for, can it easily be conceived, that a very thin layer of one kind of matter being deposited, and this, let it be supposed, of a white colour, the solution was changed, from which proceeded another thin layer; that the solution was again changed, and deposited a third kind of matter; and after another change, a fourth kind, or perhaps that the deposition of the first kind of matter again commenced. But if infiltration from an aqueous solution have really been the mode of formation of this mineral, how comes it, it may be fairly asked, that the depositions from the different kinds of solution have not been arranged, at least in the larger cavities, in strata or zones parallel to the horizon; because it seems natural to suppose that the deposition of stony matter, from a state of solution in water, would be influenced by gravitation, and thus be horizontally arranged? We are aware, indeed, of an objection which may be made to this observation. It will be said that the influence of gravity has in this case been counteracted by the action of affinity between the stony matter in solution, and the sides of the cavity in which the agate is formed; but whatever effect this might have in the smaller cavities, its influence would be diminished in those of larger capacity.

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To what we have now said on this subject, which, it must be acknowledged, is more curious than useful, we shall only add a circumstance which, so far as we know, has not been noticed by geologists; but it seems to be of considerable importance to the establishment or subversion of the theory of the formation of agate by means of infiltration in the state of aqueous solution. It will be allowed, we presume, that all agates found in the same horizontal position, or at the same depth from the surface, from which the aqueous solution is understood to have proceeded, were formed from the same solutions; at least those agates which are contiguous to each other, that is, within the space of a few yards, or even of a single yard. Now, if this be admitted, all the agates which have derived their materials from the same solutions, ought to be exactly of the same kind, because their origin is cotemporaneous, and it is derived from the same solutions. To ascertain this point with precision, it will be necessary to examine agates in their native repositories; and although we shall not pretend confidently to decide the question, because our observations with this view have not been sufficiently varied and extensive, yet we strongly suspect, that it will appear, from future investigations, that agates, and even such as are almost contiguous to each other, have been formed of very different materials, or of similar materials arranged in a very different manner. To those who are fond of such speculations we recommend this as a subject of investigation.

Localities.—Agates are found in great abundance in different parts of the world. They are sometimes distributed indiscriminately with the rocks which contain them, sometimes in beds or layers, in interrupted masses, and sometimes in thin beds, where there is scarcely any interruption of continuity. This last mode of arrangement, however is rare. Agates are sometimes found in metallic veins, or are mixed with metallic substances,

Classification.

as the sulphurets of lead and silver. It would appear, too, that agates also exist in primitive rocks. Saussure has observed them in granite, containing nodules of the same granite, and penetrated with iron pyrites. He has observed also at the same place, near Vienne, in the department of Isere, thin layers of calcedony alternating with gneis; but porphyries and similar rocks are the usual repositories of agate. These stones are found in great variety and abundance at Oberstein, in the department of Mont-Tonerre, in France, in a rock of amygdaloid of a peculiar nature, and full of cavities of all sizes. This rock is considered by Dolomieu as a volcanic tufa; but according to other mineralogists, and particularly Faujas de St Fond, who has given a minute description of it*, it is considered as a porphyry or amygdaloid, with a basis of trap, which is very subject to decomposition. The globular masses of agate are disposed in this rock without any order, and are usually enveloped with a peculiar greenish earth, but which contains no copper. In the geodes of agate found at Oberstein, jasper, amethyst, carbonate of lime in crystals, chabasie, a species of zeolite, and some portion of titanium, have been observed; but not the least trace of any organized body. Digging, polishing, and forming into a great variety of ornamental objects, constitute the chief employment of the inhabitants of Oberstein.

* *An. du Museum D'Hist. Nat.* III. 53.

Agates are found in abundance in different parts of Scotland: but the largest and finest are met with in the neighbourhood of Montrose and Stonehaven; in the rocks near Dunbar on the east coast, and in the rocks about Dunure, on the shore of Carrick in Ayrshire.

32. Species. HYALITE.

Id. Kirw. i. 296. *Muller's glass* of the Germans. *Lava glass* of many.

Exter. Char.—This substance is found in grains or masses, or in thin layers on other minerals. It has much the appearance of gum, and is usually cracked. The lustre is shining and vitreous; fracture conchoidal, sometimes foliated; fragments sharp-edged.

Colour grayish white or yellowish; and, according to Kirwan, pure white. Translucent, sometimes semitransparent; has considerable hardness, and is brittle. Spec. grav. 2.110.

Chem. Char.—Infusible at 150° Wedgwood, but melts with soda.

Constituent Parts.	
Silica,	57
Alumina,	18
Lime,	15

With some traces of iron.

Localities, &c.—Hyalite is found in rocks of amygdaloid, or wacken, near Franckfort on the Maine.

33. Species. OPAL.

This species is divided into four subspecies or varieties.

Subspecies 1. PRECIOUS OPAL.

Opal, Kirw. i. 289. *L'Opale Noble*, Brochant, i. 341. *Quartz-resinite Opalin*, Hauy, ii. 434.

Siliceous genus.

Exter. Char.—This mineral is found massive or disseminated, and sometimes in veins; internal lustre splendent and vitreous; fracture perfectly conchoidal; fragments sharp-edged.

Colour milk-white, clear or pale, and sometimes bluish gray; and by holding it in different lights, a very bright and varied play of colours, the principal of which are golden yellow, scarlet red, bright blue, green and gray, is seen. It is commonly translucent, rarely semitransparent; pretty hard and brittle. Spec. grav. 2.114

Chem. Char.—The precious opal treated with the blow-pipe splits and cracks, and loses its transparency, but is not melted.

Constituent Parts.	Klaproth.
Silica,	90
Water,	10
	100

Localities.—The finest opals are found at Czerwenitza not far from Casehau in Upper Hungary, in an argillaceous decomposed porphyry, which according to some mineralogists is a gray stone (graustein of the Germans), and are disposed in veins, nests, and grains. When the opal adheres in small particles closely together in the stone, it forms what is called *mother* of opal. It is found in the same manner in a kind of breccia of this decomposed porphyry. (Townson's Travels in Hungary, p. 307.). It is found also at Eibenstock, Johann-Georgenstadt, and Freyberg in Saxony. At this latter place the repository of the opal is porphyry. The opal also is met with in Iceland.

The opal mines described by Dr Townson are situated in a hill of some miles in extent not far from the village of Czerwenitza. This hill has been opened in several places, but in three with the greatest success. Guards are placed upon it to prevent any person from digging this precious stone; for as it is situated in part of the royal domain, the peasants who were formerly permitted to search for it on their own account are now prohibited by the emperor. But even at the time Dr Townson visited the mines the work had been discontinued for three or four years as unprofitable. The usual mode of conducting the operations in searching for the opal is by quarrying to the depth of three or four yards, rarely deeper. The rock is thus thrown out, broken to pieces, and afterwards examined. In one place the search had been made by mining; but the gallery was only a few yards in length. From this account it appears that the rock containing the opal lies near the surface, and seldom, it is said, extends deeper than a few fathoms. The opals denominated *oriental* by the lapidaries, a term expressive of their value rather than of their origin, are supposed to be from these mines, in which, according to records still in existence, 300 men were employed not less than 400 years ago.

Uses.—On account of the fine play of colours, the opal is held in great estimation for the purposes of jewellery, and the opals which reflect green colours in most abundance are most highly valued. The finest opals are called oriental; but this epithet is given by the lapidaries to the more perfect precious stones, and is not to be understood as denoting that they have been brought from eastern countries.

Siliceous genus.

The ancients, it would appear from the account of Pliny, attached an immense value to this stone; for he informs us that a senator called Nonius rather submitted to banishment than give up an opal which he had in his possession to Mark Anthony. This opal was estimated at 20,000 sesterees. Lib. xxxvii. cap. 6.

Subspecies 2. Common Opal.

Semi-opal, Kirwan, i. 290. *L'Opale Commune*, Brochant. i. 344. *Quartz resinite Hydrophane* et *Quartz resinite Girasol*, Hauy, ii. 433.

Exter. Char.—Common opal is found in masses, or disseminated, sometimes in rounded or angular pieces, and sometimes kidney-shaped or botryoidal. Internal lustre splendent, and intermediate between vitreous and resinous. Fracture conchoidal, but sometimes uneven. Fragments sharp-edged.

Colour milk-white, and varieties of this colour held in certain directions appear of a wine yellow. The other shades of colour are yellowish or reddish white, and wax or honey yellow. Semitransparent and sometimes transparent. Specific gravity from 1.958 to 2.015. In other characters the same as the precious opal.

Chem. Char.—Infusible before the blow-pipe, but melts with borax, and without swelling up.

Constituent Parts. Klaproth.

	From Kozemutz.		From Telkobanya.
Silica,	98.75	Silica,	93.50
Alumina,	0.10	Oxide of iron,	1.00
Oxide of iron,	0.10	Water	5.00
Loss,	1.05	Loss	
	100.00		100.00

Localities, &c.—The common opal is found in veins, chiefly in amygdaloid rocks, and sometimes also, it is said, in granites and porphyries. It is of most frequent occurrence in Bohemia; in Saxony, as at Freyberg, Eibenstock, &c.; in Hungary, in Poland, in Scotland, and the Faroe islands. The amygdaloid rocks in the vicinity of the Giants Causeway in the north of Ireland also afford a repository for this mineral.

Uses.—It is employed as well as the former for the purposes of jewellery, but is esteemed of inferior value.

It has been observed of some varieties of common opal that they are hydrophanous, that is, they possess the property of becoming transparent when immersed in water, a property which it is supposed depends on the absorption of the water in the pores of the opal. When similar varieties of opal are dipped in melted wax, they are impregnated with it, and become in like manner transparent, but on cooling resume their opacity. To such varieties De Born has given the name of *Pyrophane*.

Subspecies 3. Semi-opal.

Id. Kirwan, i. 290. *La Demi-opale*, Brochant, i. 347. *Quartz Resinite Commune, et Menilite*, Hauy, ii. 433.

Exter. Char.—This mineral is found in masses or disseminated, in angular fragments, stalactitical, botryoidal, or in superficial layers. Lustre glimmering or shining, and intermediate between vitreous and resinous. Fracture conchoidal, and frequently even. Fragments sharp-edged. Classification.

Colours extremely various, but in general duller and less vivid than common opal. The most predominant are yellowish, grayish and reddish white, more rarely milk white. Various colours are sometimes disposed in spots, stripes, and clouds. Translucent at the edges, and sometimes, but rarely, semitransparent. Pretty hard and brittle. Spec. grav. 2.540.

Chem. Char.—Infusible before the blow-pipe, but melts with borax and without frothing up.

Constituent Parts. Klaproth.

Silica,	43.50
Oxide of iron,	47.00
Water,	7.50
Loss,	2.00
	100.00

Localities, &c.—The semi-opal is found in the same places and in similar rocks with the common opal, as in basalt and amygdaloid, but chiefly in granite and porphyry, and particularly in the veins of such rocks containing silver.

Some varieties of pitch stone have been ranked with semi-opal by mineralogists; and menilite, a mineral to be afterwards described, has been also considered merely as a variety of it.

Subspecies 4. Wood Opal.

Ligniform Opal, Kirwan, i. 295. *Opale Ligniforme*, Brochant, i. 350. *Quartz resinite Xyloide*, Hauy, ii. 439.

Exter. Char.—This variety of opal is found in masses of different sizes, retaining the form and texture of the wood which is supposed to be penetrated with the stony opaline matter. Lustre interally weakly shining, between vitreous and resinous. Transverse fracture conchoidal, longitudinal fracture shows the woody texture. Fragments sharp-edged.

Colours grayish and yellowish white, yellowish brown and ochre yellow. Different colours are sometimes arranged in concentric circles, in spots, and stripes. Often opake, but rarely translucent except at the edges. Intermediate between hard and semi-hard. Brittle. Spec. grav. 2.600.

Localities, &c.—The wood opal is found at Pornick near Schemnitz in Hungary, and at Telkobanya in the same country.

34. Species. Menilite.

Pitchstone, Kirwan, i. 292. Variety of *flint* of some, and *Semi-opal* of Klaproth.

Exter. Char.—This mineral is found in tuberose masses, which have a smooth ribbed surface, and are sometimes covered with a whitish crust. Internal lustre weakly shining. Transverse fracture flat, conchoidal; longitudinal, coarse, splintery. Fragments sharp-edged.

Chesnut brown colour, and marked with alternating stripes of pearl gray and reddish brown. Translucent. Pretty hard and brittle. Spec. grav. 2.185.

Constituent

Classification.

Constituent Parts.	Klaproth.
Silica,	85.50
Alumina,	1.
Oxide of iron,	.50
Lime,	.50
Water and carbonaceous matter,	11.50
Loss,	1.
	100.00

Localities, &c.—This mineral is found at Menil-Montant, from which it derives its name, near Paris, in nodules disposed in interrupted strata, in the middle of a foliated, argillaceous schistus, which is interposed between the beds of gypsum.

35. Species. Jasper.

Jasper has been divided into six subspecies, 1. Egyptian; 2. Striped; 3. Porcelain; 4. Common; 5. Agate; and, 6. Opal.

Subspecies 1. Egyptian Jasper.

Egyptian Pebble, Kirwan, i. 312. *Le Jaspe Egyptien*, Brochant, i. 332.

Exter. Char.—This variety of jasper is found in rounded pieces, which are generally spherical, and have a rough surface. External lustre glimmering or weakly shining; internal weakly shining. Fracture perfect conchoidal; fragments sharp-edged.

The colours of this variety are disposed in zones or irregular stripes, which are nearly concentric. These colours are yellowish brown on a ground of chesnut brown; usually opaque, or slightly translucent at the edges. Spec. grav. 2.56 to 2.6.

Chem. Char.—Infusible before the blow-pipe.

Localities, &c.—This mineral, as its name imports, is brought from Egypt, where, as was observed by Cordier, it constitutes part of a breccia which is entirely composed of fragments of siliceous stones, immense strata of which abound in that country, and the deserts of Africa in the vicinity. The masses of jasper are found among the sand which has been derived from the decomposition of this breccia, and particularly near Suez.

Uses.—This variety, on account of its hardness and beautiful colours, is in considerable estimation for ornamental purposes.

Subspecies 2. Striped Jasper.

Id. Kirw. i. 312. *Le Jaspe Rubané*, Broch. i. 334. *Quartz-Jaspe Onyx*, Hauy, ii. 436.

Exter. Char.—This variety of jasper is found massive, and sometimes forms entire beds. It has no lustre, except from the mixture of extraneous substances. Fracture conchoidal, sometimes splintery or earthy. Fragments sharp-edged.

To the variety of colours of this mineral it owes its name. These are pearl gray, yellowish and greenish gray, with shades of red and blue, and these different colours are arranged in straight or curved lines; generally opaque, translucent only at the edges.

Localities, &c.—This variety of jasper abounds in Siberia: it is found also in Saxony, in the Hartz, where it reposes on gray wacken; in Sicily; and in the hills in the vicinity of Edinburgh. Siliceous genus.

Subspecies 3. Porcelain Jasper.

Porcellanite, Kirw. i. 313. *Le Jaspe Porcelaine*, Broch. i. 336. *Thermantide Porcellanite*, Hauy, iv. 510.

Exter. Char.—Usually found in masses or angular pieces, in which rents or fissures are often observed, and also in whole beds. Internal lustre glimmering or weakly shining; resinous. Fracture imperfect conchoidal or uneven. Fragments sharp-edged.

The colour exhibits great variety; pearl, ash, yellowish and bluish gray, with shades of yellow, red, and rarely green. The colour is generally uniformly the same, but sometimes it is striped and dotted, flamed and clouded; impressions of vegetables of a red colour are observed on the blue varieties, and the rents or fissures are of a red colour in the grayish specimens; is entirely opaque; pretty hard, and easily frangible.

Chem. Char.—Melts before the blow-pipe into a black slag.

Constituent Parts.	Rose.
Silica,	60.75
Alumina,	27.27
Magnesia,	3.
Potash,	3.66
Oxide of iron,	2.50
	97.18
Loss,	2.82
	100.00

Localities, &c.—This mineral is abundant in different parts of Bohemia; it is met with also in Saxony, in the rocks in the vicinity of Edinburgh, and on the coast of Fife near Dysart in Scotland.

This jasper derives its name from its fracture, which resembles that of porcelain; and as it is frequently found in places where subterraneous fires have existed, such as beds of coal which have been kindled by accident, it is ascribed to their action; and according to Werner, it is nothing more than a slaty clay altered by fire.

Subspecies 4. Common Jasper.

Id. Kirw. i. 310. *Jaspe Commun*, Broch. i. 338.

Exter. Char.—This variety is usually found massive, sometimes disseminated, or alternating in thin layers with other stones. Lustre glimmering or shining, between vitreous and resinous. Fracture more or less perfectly conchoidal, sometimes splintery or earthy. Fragments sharp-edged.

Colours extremely various, exhibiting different shades of red, yellow, and black; and several of these are united together, presenting clouds, spots, and stripes. Usually opaque, or slightly translucent at the edges. Is scratched by quartz. Easily frangible. Spec. grav. 2.3 to 2.7.

Chem. Char.—Entirely infusible before the blow-

Siliceous genus.

pipe. Its constituent parts are extremely variable. The following were obtained by the analysis of Kirwan:

Silica,	75
Alumina,	20
Oxide of iron,	5
	100

Localities, &c.—This jasper is very common in different parts of the world; in Saxony, Bohemia, Hungary, France, Spain, Italy, Siberia, and also in Scotland, as among the basaltic rocks in the vicinity of Edinburgh, and at Dunbar. It is usually found in veins, especially such as contain ores of iron. It is often traversed with veins of quartz, or mixed with pyrites, lithomarga, semi-opal, brown spar, native and vitreous silver. It has been taken for the basis of some porphyries, but these turn out to be indurated clay, pitch stone, and horn stone.

Subspecies 5. Jasper Agate.

Exter. Char.—This variety seems to be the same as that already mentioned under the name of *agate jasper*, in speaking of agates at the end of the description of calcedony. It is found massive, and possesses no lustre. Fracture conchoidal, generally opaque, pretty hard, and sometimes adheres to the tongue. The colours are yellowish or reddish white, which are disposed in stripes and circles.

Localities, &c.—It is met with in many places in agate balls, in amygdaloid rocks.

Subspecies 6. Opal Jasper.

Exter. Char.—This variety of jasper seems to possess many common characters with some varieties of opal. It is found massive. Internal lustre between vitreous and resinous, is shining or resplendent. Fracture conchoidal. Fragments very sharp-edged.

Colours scarlet red, blood red, brownish red, more rarely yellow. Colours disposed in veins, spots, and clouds. Opaque, or translucent at the edges. Brittle, and easily frangible.

Localities, &c.—This mineral is found in Hungary, in Siberia, and other places, and is usually in nests in porphyry.

Beside the localities of the different varieties of jasper already mentioned, we may notice that it is met with in Siberia of a white and bluish colour. The hill on which the fortress of Orskaia stands on the left bank of the river Jaik, in the government of Orembourg, is entirely composed of a pale green and deep red jasper, disposed in inclined beds; and on the most elevated parts of the Altaian mountains, near the source of the river Korgou, a jasper has been discovered of an ivory white colour, which is remarkable for being penetrated with black dendrites.

Uses of Jasper.—It is valued according to its hardness, the degree of polish of which it is susceptible, and the beauty and variety of its colours; and it is employed in forming vases, handles for swords and knives, and other smaller ornamental purposes.

36. Species. Heliotrope, or *Bloodstone*.

Heliotropium, Kirw. i. 314. *L'Heliotrope*, Broch. i. 276. *Quartz jaspe Sanguin*, Hauy, ii 436.

Classification.

Exter. Char.—Heliotrope is found massive or in angular pieces; external lustre glimmering or shining, and resinous; fracture conchoidal, sometimes uneven. Fragments very sharp-edged.

Colour chiefly deep green, but of various shades, with spots of olive and yellow, but most frequently scarlet or blood red: translucent at the edges: hard, easily frangible. Spec. grav. 2.62 to 2.7.

Chem. Char.—Entirely infusible before the blow-pipe.

Localities, &c.—This mineral was originally brought from the east, but it has since been found in Siberia, in Bohemia, where it is met with in a vein, and in Iceland.

Uses.—It is employed for similar purposes with jasper or agate.

By many mineralogists this mineral is considered as a variety of jasper; hence it has been called oriental jasper; and it is supposed by some to be a calcedony penetrated with green earth.

37. Species. Chrysoprase.

Chrysoprasium, Kirw. i. 284. *La Chrysoprase*, Broch. i. 280. *Quartz Agathe Prase*, Hauy, ii. 426.

Exter. Char.—This mineral is found massive, or in angular fragments: internal lustre rarely glimmering; fracture even, sometimes splintery; fragments sharp-edged.

Colour apple-green, greenish gray, or leek-green; translucent, sometimes semitransparent; less hard than calcedony and flint. Spec. grav. 2.25.

Chem. Char.—Infusible before the blow-pipe, but loses its transparency, and becomes white.

Constituent Parts.	Klaproth.
Silica,	96.16
Alumina,	.08
Lime,	.82
Oxide of iron,	.08
Oxide of nickel,	1.00
Loss,	1.86
	100.00

Localities, &c.—Chrysoprase is found at Kosemutz, in Upper Silesia, in a mountain composed of serpentine, asbestus, indurated talc, and lithomarga.

Uses.—It is employed for similar purposes as jasper, and it is greatly esteemed when it is of a fine apple-green colour. It is said that some varieties of this mineral lose their colour by being exposed to moisture, so that the jewellers, before using them, put them to the test, by keeping them for some time in a moist place.

38. Species. Plasma.

Id. Broch. i. 278. *Silex Plasme*, Brongniart, ii. 398.

Exter Char.—This mineral is found disseminated, in rounded pieces, and also in angular pieces. Internal lustre glimmering or weakly shining; resinous. Fracture conchoidal, even, and sometimes splintery. Translucent, and sometimes even transparent in thin pieces.

Colour various shades of green; and sometimes different colours are disposed in spots, stripes, and points.

Nearly

Classification. Nearly equally hard with calcedony. Brittle, and easily frangible.

Chem. Char.—It is infusible before the blow-pipe, but becomes white.

Localities, &c.—It is said by some, that this mineral has only been found among the ruins of Rome, but according to Brongniart and others, it has been found in the Levant, in Upper Hungary, and in Moravia, in a mountain of serpentine, where it is accompanied with flint.

Uses.—It appears that this mineral was much employed by the ancients for ornamental purposes.

39. Species. Cat's Eye.

Id. Kirw. i. 301. *L'Oeil de Chat*, Brochant, i. 292. *Quartz-Agathe Chatoyant*, Haüy, ii. 427.

Exter. Char.—This mineral, as it is brought from its native country, is usually cut and polished, so that its natural form is unknown; but it is supposed that it is met with in grains or rounded pieces. A mass described by Klaproth, which seemed to be in its natural state, had a quadrangular form, a rough surface, and considerable brilliancy. The lustre is resplendent and resinous. The cross fracture is uneven, the longitudinal fracture imperfectly foliated. Fragments more or less sharp-edged.

The colour is greenish yellow and smoke gray, of various shades, and sometimes, but rarely, grayish or silvery white. It is translucent, rarely semitransparent. When it is cut, it reflects different rays of light by changing its position, a character by which it is easily known. This is ascribed to small parallel fibres which appear in the interior of the stone. It is hard, easily frangible. Spec. grav. 2.625 to 2.660.

Chem. Char.—It melts with great difficulty by the action of the blow-pipe. Klaproth subjected it to the heat of a porcelain furnace, but it was not melted; it only lost its hardness, lustre, and transparency, and the colour became of a pale gray.

Constituent Parts. Klaproth.

Silica,	95.00	94.50
Alumina,	1.75	2.00
Lime,	1.50	1.50
Oxide of iron,	0.25	0.25
Loss,	1.50	1.75
	100.00	100.00

Localities.—Cat's eye is brought from Ceylon and the Malabar coast, and also, it is said, from Egypt and Arabia; but always in the polished state. The only one known in its natural state was that above mentioned, which was presented to Klaproth by Mr Greville of London.

Uses.—This mineral is in great estimation as a precious stone, and it is usually cut for ring-stones.

The name is derived from its possessing the property of reflecting the light similar to the eye of the cat, and hence the term *chatoyant* among jewellers, which is expressive of that effect.

49. Species. Obsidian.

Id. Kirwan, i. 265. *Iceland agate* vulgo. *L'Obsidienne*, Brochant, i. 288. *Lave vitreuse Obsidienne*, Haüy, iv. 594. Siliceous genus.

Exter. Char.—This mineral is found in masses, and sometimes in rounded pieces. Lustre resplendent, vitreous; fracture perfectly conchoidal; fragments very sharp-edged.

The most common colour of obsidian is perfectly black, sometimes greenish and grayish, black, blueish, greenish and smoke gray, and yellow and red, according to Humboldt: most commonly opaque, but sometimes translucent on the edges. It is hard and easily frangible. Spec. grav. 2.348.

Chem. Char.—Before the blow-pipe obsidian melts into an opaque porous glass, of a grayish white colour.

Constituent Parts.

	Bergman.	Abilgaard.
Silica,	69	74
Alumina,	22	12
Oxide of iron,	9	14
	100	100

	Descotils.	Drappier.	
Silica,	72.0	74.	71.0
Alumina,	12.5	14.	13.4
Lime,		1.2	1.6
Oxide of iron and manganese,	2.0	3.0	4.0
Potash and soda,	10.0	3.3	4.0
Loss,	3.5	4.5	6.0
	100.0	100.0	100.0

Localities, &c.—This mineral is found in Iceland, in Siberia, in the Lipari islands, in Hungary, in Madagascar, the island of Teneriffe, in Mexico, Peru, and some of the South sea islands. Humboldt discovered a variety of obsidian in New Spain, which was *chatoyant* in a considerable degree. The obsidian from Hungary is found in insulated pieces among detached masses of granite, gneiss, and decomposed porphyry. Obsidian was long supposed to have a volcanic origin; but it appears, from the accounts of those who have visited Iceland, that it is not only found in the vicinity of Hecla, but everywhere, distributed like quartz and flint; and besides it is not unfrequent in countries where volcanoes were never known to exist.

Uses.—The fine colour and hardness of this stone have brought it into use for ornamental purposes. Among the ancient Mexicans and Peruvians it was employed as mirrors, some of which, it is said are sometimes still found in the tombs of their ancient sovereigns (*Faujas Miner. des Volcans*, p. 308.); and also for cutting instruments as knives and even razors. Humandez saw the Mexican cutlers make a hundred knives of obsidian in the course of an hour. Obsidian, it is said, has also been used as mirrors for telescopes.

41. Species. Pitchstone.

Id. Kirwan, i. 292. *La pierre de poix.* Brochant, i. 353. *Petrosilex resiniforme*, Haüy, iv. 386.

Exter. Char.—Pitchstone, which has received its name

Siliceous genus.

name from its resemblance to pitch, is found massive sometimes in extensive beds and veins, and also forming entire mountains. Internal lustre shining and resinous. Fragments sharp-edged. In coarse and frequently small granular distinct concretions which have a smooth surface.

The colours are various shades of black, green, brown, red, and gray. Translucent, but commonly at the edges only. Brittle, and rather easily frangible. Spec. grav. of pitchstone from Saxony, 2.314; of black pitchstone from Arran, 2.338; of pitchstone from Meissen 1.645, Klaproth.

Chem. Char.—Fusible by the blow-pipe, and is converted into a white porous enamel.

Constituent Parts of pitchstone from Meissen of an olive green colour. Klaproth, Transl. ii. 207.

Silica,	73
Alumina,	14.50
Lime,	1
Oxide of iron,	1
Oxide of manganese,	0.10
Soda,	1.75
Water,	8.50
Loss,	1.5
	100.00

Localities, &c.—Pitchstone is found in great abundance in Saxony, in Hungary, and also in Siberia. It abounds also in Scotland, particularly in the island of Arran, where it is met with in beds, but chiefly in veins traversing the strata in the less elevated parts of the island. Pitchstone also forms the basis of a porphyry.

42. Species. PEARLSTONE.

Obsidienne Perlée, Brongniart, ii. 340. *Lave Vitreuse Perlée*, Hauy, iv. 495. *Volcanic Zeolite*, Fichtel. *Zeolitic Pitchstone* of others. See Klaproth, Transl. ii. 263.

Exter. Char.—Pearlstone almost always forms the ground or basis of a species of porphyry which contains roundish or longish vesicular cavities. Lustre pearly. Fracture seems imperfectly conchoidal; but is not very perceptible. Fragments blunt-edged.

Colour bluish, ash, greenish gray. Translucent at the edges. When breathed upon, gives out the argillaceous odour. Not brittle, but easily frangible. Soft. Spec. grav. 2.340 to 2.548.

Chem. Char.—Before the blow-pipe froths up like zeolite, but is not fused.

Constituent Parts. Klaproth, ii. 267.

Silica,	75.25
Alumina,	12.
Oxide of iron,	1.60
Lime,	.50
Potash,	4.50
Water,	4.50
Loss,	1.65
	100.00

Localities, &c.—Pearlstone is found near Tokay in Hungary, in strata alternating with those of argillaceous porphyry, and containing in its vesicles nodules of obsidian; it is also met with in Iceland, and in the north of Ireland.

Classification.

43. Species. PUMICE.

Id. Kirwan, i. 415. *La Pierre ponce*, Brochant, i. 443. *Ponce*, Brongniart, i. 332. *Lave vitreuse pumicée*, Hauy, iv. 495.

Exter. Char.—This mineral is found massive or disseminated, and it is always of a porous or vesicular texture.

Lustre glimmering, or a little shining and silky. Fracture fibrous; fragments blunt-edged.

Colour grayish white, bluish, or yellowish gray. Opaque, rarely translucent at the edges, sometimes semihard, but generally soft, very brittle, and very easily frangible. Spec. grav. 0.914.

Chem. Char.—Fusible before the blow-pipe, and is converted into a white glass.

Constituent Parts. Klaproth, ii. 208.

Silica,	77.50
Alumina,	17.50
Oxide of iron,	1.75
Soda of potash,	3.
Loss,	.25
	100.00

Localities, &c.—Pumicestone has been supposed to be a volcanic production, because it is found in the vicinity of volcanoes; the Lipari islands are almost entirely composed of it, and there it is accompanied with obsidian. It is also found in Iceland and Teneriffe; in Hungary; and on the banks of the Rhine between Andernach and Coblentz.

Uses.—Pumice is very much employed in polishing stones, metals, glass, ivory, and in the preparation of parchment.

A rare variety of pumice is described by Brongniart in the form of vitreous filaments as fine as hair; the colour is a deep bottle green, and it melts by heat into a white enamel. This pumice is supposed to be projected from the volcano in the isle of Bourbon.

44. Species. PREHNITE.

Id. Kirwan, i. 274. *La Prehnite*, Brochant, i. 295. *Prehnite*, Hauy, iii. 67.

Essen. Char.—Divisible by one distinct line only, and pretty clean; electric by heat.

Exter. Char.—Prehnite is found either massive or crystallized. The principal form of its crystals is a four-sided rhomboidal table, which is either perfect or truncated on all its edges, or a table with six faces, and an equal angle, or a large rectangular prism terminated by a bevelment which is somewhat obtuse. The crystals are usually grouped together, and united by their lateral faces; face of the crystals smooth; external lustre shining; internal weakly shining and pearly; principal fracture foliated, cross fracture fine-grained uneven; fragments but little sharp-edged.

Colour

Classification.

Colour green, olive green, mountain green, and greenish white; semitransparent, and sometimes transparent. Scratches glass slightly. Brittle, and easily frangible. Spec. grav. 2.609 to 2.696.

Chem. Char.—Fusible before the blow-pipe, into a white porous enamel.

Constituent Parts.

	Hassenfratz.	Klaproth.
Silica,	50.	43.83
Alumina,	20.4	30.33
Lime,	23.3	18.33
Oxide of iron,	4.9	5.66
Water,	.9	1.83
Magnesia,	.5	—
Loss,	—	0.02
	100.0	100.00

Localities.—Prehnite was brought first from the Cape of Good Hope, by Colonel Prehn, whose name it now bears. It is also found in France, as in Dauphiny, where it exists in veins. It is not unfrequent in different parts of Scotland, as among the porphyry rocks six miles to the south of Paisley; in the neighbourhood of Dunbarton; and in the rocks round Edinburgh.

45. Species. Zeolite.

This species has been divided into four subspecies.

Subspecies 1. Mealy Zeolite.

Zeolite, Kirwan, i. 278. *La Zeolite Farineuse*, Brochant, i. 298. *Mesotype*, Hauy, iii. 151.

Exter. Char.—This variety is found massive or disseminated, and sometimes it is branched or coralloidal, and sometimes also it envelopes other zeolites with a thin crust. It is dull; fracture earthy; fragments blunt-edged.

Colour usually reddish or yellowish white, or flesh red, opaque, very brittle; does not adhere to the tongue. When scratched with the finger nail it gives out a dull sound.

Constituent Parts.	Pelletier.
Silica,	50
Alumina,	20
Lime,	8
Water,	22
	100

Localities, &c.—This variety of zeolite is found in Ireland, the Faro islands, and Sweden. It is frequent in different parts of Scotland, as at Dunbar, and several of the Western islands.

Subspecies 2. Fibrous Zeolite.

Zeolithe Fibreuse, Brochant, i. 299. *Mesotype*, Hauy, i. 151.

Exter. Char.—This variety is found massive, and sometimes in rounded pieces, composed of capillary crystals, divergent and radiating; internal lustre glimmering, or weakly shining, pearly or silky; fracture fibrous; fibres divergent; fragments wedge-shaped. Siliceous genus.

Colour yellowish white, yellowish brown, snow white, and sometimes honey yellow, translucent; semihard, brittle, and easily frangible. Light.

Constituent Parts.	Meyer.
Silica,	41
Alumina,	31
Lime,	11
Water,	15
Loss,	2
	100

Subspecies 3. Radiated Zeolite.

Zeolithe Rayonnée, Brochant, i. 301. *Mesotype*, Hauy, iii. 151.

Essen. Char.—Divisible parallel to the faces of a rectangular prism; electric by heat in two opposite points.

Exter. Char.—This variety is found massive, but most frequently crystallized: the primitive form is a rectangular prism with square bases; its common forms are a rectangular prism, truncated at each extremity by a four-sided pyramid, corresponding to the lateral faces; a four-sided rectangular prism with two broad and two narrow sides, and also terminated by four-sided pyramids, or a four-sided prism, nearly rhomboidal, the two sharp lateral edges of which, as well as the two obtuse terminal angles, are truncated. The crystals are united together in bundles; so that the acuminations only can be seen; the crystals are commonly smooth and shining; the internal lustre is weakly shining and pearly; fracture radiated: the rays broad or narrow; fragments wedge-shaped.

Colour yellowish, grayish, reddish, and snow-white; translucent, sometimes transparent; semihard; scratches calcareous spar; brittle, and easily frangible. Spec. grav. 2.0833.

Chem. Char.—Before the blow-pipe it froths up, gives out a phosphorescent light, and is converted into a porous enamel. With acids it forms a gelatinous substance.

Constituent Parts.	Vauquelin.
Silica,	50.24
Alumina,	29.30
Lime,	9.46
Water,	10.
Loss,	1.
	100.00

Subspecies 4. Foliated Zeolite.

Zeolithe Lamelleuse, Brochant, i. 302. *Stilbite*, Hauy, iii. 161.

Essen. Char.—Fusible into a spongy enamel, but not electric by heat.

Exter. Char.—This variety of zeolite is usually found in amygdaloidal or globular pieces, and also crystallized; primitive form of its crystals is a rectangular prism with rectangular bases: the usual forms of its crystals are,

Siliceous genus.

are, a short equiangular six-sided prism with two broad, two narrower, and two very narrow faces; a table with six equal faces, and a rhomboidal prism. Surface of the crystal smooth and shining; internal lustre shining and pearly; fracture foliated; the plates most frequently curved with a simple cleavage.

Colour similar to the former; it is translucent or semitransparent; semihard, and easily frangible. Spec. grav. 2.5.

Chem. Char.—Froths up and phosphoresces, under the blow-pipe; placed on hot coals, it becomes white and is easily reduced to powder. It is not converted into a jelly by acids.

Constituent Parts.	Vauquelin.
Silica,	52
Alumina,	17.5
Lime,	9
Water,	18.5
Loss,	3
	100

Localities, &c.—The different varieties of zeolite are usually found in amygdaloid rocks, basalts, porphyry, slate, wacken, and green stone. They often line the sides of fissures passing through these rocks, and are accompanied with calcareous spar, calcedony, sometimes with native copper and native silver, as in Iceland. The finest zeolites are brought from the islands of Faroe, Iceland, Ædelfors in Sweden. The different varieties are not unfrequent in Scotland. The fibrous and radiated kinds are met with extremely beautiful in the islands of Cannay and Skye; the foliated or stilbite in the island of Staffa, in Skye, and in the lead veins at Strontian.

46. Species. CUBIZITE.

La Zeolithe Cubique, Brochant, i. 304. *Analcime, & Chabasie*, Hauy. iii. 180.

Essen. Char.—Original forms of the cube, fusible into a glass.

Exter. Char.—This mineral is found massive or crystallized; the form of the crystals is a perfect cube, which is its primitive form. This is sometimes truncated on all its angles by three small triangular faces, or with twenty-four equal and similar trapezoids like the garnet. The external lustre is resplendent, vitreous, or pearly. Internal shining or weakly shining. Fracture imperfectly foliated, almost uneven. Fragments imperfect cubes.

Colour white, yellowish, grayish, or reddish white. It is translucent or opaque. Semihard. Spec. grav. about 2 (Hauy). Difficult to produce any signs of electricity; hence the name *analcime*, signifying want of power, given to it by Hauy.

Chem. Char.—Froths up before the blow-pipe, and melts into a porous glass.

Localities, &c.—Cubizite is found in Skye, in Staffa, and in the Salisbury rocks near Edinburgh. Fine specimens of cubizite are abundant at the Giants causeway in the north of Ireland. Chabasie is found also at Oberstein in Germany.

By many mineralogists chabasie and analcime are considered as one species; but more nearly investigated, as has been done by Hauy and others, they must appear very different. The preceding description refers chiefly to analcime. We shall shortly state the principal characters of chabasie from Hauy, iii. 176. Classification.

Essen. Char.—Divisible into a rhomboid slightly obtuse, and easily fusible by heat.

Exter. Char.—Chabasie is commonly crystallized. Primitive form of the crystals is a slightly obtuse rhomboid, whose plane angle at the summit is about $93\frac{10}{2}$°, so that it approaches nearly to the cube; integrant molecule is the same. Six of the edges are truncated, the truncations uniting three and three at the two opposite angles, and the remaining six angles are also truncated. It appears also in the form of double six-sided pyramids applied base to base, having the six angles at the base, and the three acute edges of each pyramid truncated.

Colour whitish, sometimes reddish, but this seems to be owing to a superficial crust. Lustre shining or resplendent and vitreous. Transparent or translucent.

Chem. Char.—Is easily fusible before the blow-pipe, and melts into a whitish spongy mass.

47. Species. CROSS-STONE.

Staurolite, Kirwan, i. 282. *Pierre Cruciforme*, Brochant, i. 311. *Harmotome*, Hauy, iii. 191.

Essen. Char.—Divisible into a rectangular octahedron, which may be subdivided on the angles contiguous to the summits.

Exter. Char.—This mineral is always crystallized. Its usual forms are, a double crystal composed of two broad prisms, with four rectangular faces, and terminated at each extremity by a four-sided obtuse pyramid placed on the lateral edges. These two prisms cross each other by their broader faces, so that the faces of the acumination meet together, and the double crystal thus formed having four right-angled re-entering angles, resembles a cross. The crystals are obliquely streaked. External lustre shining and resplendent, vitreous. Internal weakly shining. Fracture foliated.

Colour grayish or milky white, translucent, sometimes semi-transparent. Semi-hard, scratches glass slightly. Spec. grav. 2.333 to 3.61.

Chem. Char.—Before the blow-pipe it is fusible, and froths up. The powder thrown on hot coals is phosphorescent, giving out a greenish yellow light.

Constituent Parts.

	Klaproth.	Tassaert.
Silica,	49	47·5
Barytes,	18	16
Alumina,	16	19·5
Water,	15	13·5
Loss,	2	3·5
	100	100

Localities.—This mineral has been found in veins at Andreasberg in the Hartz, accompanied by carbonate of lime, from which it is sometimes called *andreolite*. It is also found in the lead veins at Strontian in Scotland, and in balls of agate at Oberstein. In the latter place, crystals are single.

48. Species

48. Species. Laumonite.

Zeolithe Efflorescente, Hauy, iv. 410. *Id. Brochant*, ii. 530.

Exter. Char.—This mineral is found in masses which are composed of irregular groups of crystals crossing each other in all directions. Form of the crystals is a four-sided prism, nearly rectangular, and terminated by a base inclined to one of the lateral edges under an angle of 133°; frequently the acute angle is truncated, and thus terminating in a bevelment placed on the acute lateral edges. The lateral faces are longitudinally streaked, and the lustre is shining. The faces of the summit are also shining, but smooth. Fracture foliated, and parallel to the lateral faces.

Colour grayish white, somewhat pearly. Is translucent, rather soft; sectile, and easily frangible.

But all these characters are considerably different by the action of the air. The whole mass is gradually separated, and the crystals become opaque, falling into friable folia, which are in a short time reduced to a snow-white powder, from which it derives the name given to it by Hauy.

Chem. Char.—Fusible before the blow-pipe, without frothing up, into a white enamel, and forms a jelly with acids.

Localities.—This mineral was found in 1788 by Gillet Laumont, in the lead mines of Huelgoët in Brittany in France, and from him it derives its name. It forms a small vein contiguous to the vein of galena. We have collected specimens of a mineral, whose characters correspond with laumonite, in a vein traversing a basaltic rock in the island of Skye. After being kept for some years it appeared equally liable to disintegration by exposure to the air.

49. Species. Dipyre.

Id. Brochant, ii. 508. *Id.* Hauy, iii. 242.

Essen. Char.—Divisible parallel to the faces of a regular 6-sided prism. Fusible with intumescence.

Exter. Char.—This mineral is found in small fascicular masses or crystals. Lustre shining, vitreous. Longitudinal fracture foliated.

Colour grayish or reddish white, and sometimes pale rose red. Semi-hard; scratches glass, and is easily frangible. Spec. grav. 2.630.

Chem. Char.—Fusible. The powder thrown on hot coals produces phosphorescence.

Constituent Parts.	Vauquelin.
Silica,	60
Alumina,	24
Lime,	10
Water,	2
Loss,	4
	100

Localities, &c.—This mineral has only been found at Maulcon, in the Pyrenees, in a rock of steatites. It was discovered by Lelievre and Gillet Laumont, in 1786.

50. Species. Natrolite.

Id. Klaproth. *Id.* Brongniart, i. 370.

Exter. Char.—This mineral is found in masses, in a rock of amygdaloid. External surface somewhat rough; internal lustre glimmering; fracture fibrous and radiated.

Colour brownish yellow, inclining to olive, and different colours appear in parallel and waved zones; is translucent at the edges; scarcely scratches glass; is easily frangible. Sp. grav. 2.16.

Chem. Char.—Is reduced by the blow-pipe to a white glass. Nitric acid produces no effervescence, but converts it in a few hours to a thick jelly.

Constituent Parts.	Klaproth.
Silica,	48
Alumina,	24
Soda,	16
Water,	9
Oxide of iron,	1.75
Loss,	1.75
	100.00

Localities, &c.—Natrolite has been found only at Roegau, near the lake of Constance in Switzerland, in the cavities of an amygdaloid rock. The name is derived from natron or soda, of which it contains so large a proportion.

51. Species. Azurite.

Lazulite, Klaproth, Analyt. Essays, i. 170. *Le Lazulithe*, Broch. i. 315.

Exter. Char.—This mineral has been found disseminated, massive, and crystallized in rectangular four-sided prisms. Lustre glimmering and shining. Fracture imperfectly conchoidal.

Colour indigo, Prussian, or deep smalt blue; streak lighter blue; nearly opaque, or translucent at the edges; hardness, nearly that of quartz. Brittle and easily frangible.

Chem. Char.—Infusible before the blow-pipe, but loses its colour, becomes earthy, and of a clear gray. With borax it produces a bright yellow glass. Acids have a very feeble action upon it. Klaproth ascertained that it is composed of silica, alumina, and oxide of iron; but the quantity which he operated on was too small to ascertain the proportions.

Localities, &c.—This mineral has been found at Vorau in Styria, in a rock of micaceous schistus, where it forms, along with grayish quartz and silvery white mica, a vein of about half an inch thick.

52. Species. Lazulite.

Lapis Lazuli, Kirw. i. 283. *La Pierre d'Azure*, Broch. i. 313. *Lazulite*, Hauy. iii. 145.

Exter. Char.—This mineral is found massive, disseminated, and in rounded fragments; internally dull, and rarely glimmering. Fracture earthy, or fine-grained uneven; fragments sharp-edged.

Siliceous genus.

Colour azure blue; opaque, or translucent on the edges; hard, or semihard; brittle and easily frangible. Spec. grav. 2.76 to 2.94.

Chem. Char.—It retains its colour at the temperature of 100° Wedgewood; but with a stronger heat froths up into a yellowish hard coloured mass. By increasing the heat, it changes to a white enamel; with acids after calcination, forms a jelly.

Constituent Parts.

	Klaproth. *Analyt. Ess* i. 169.
Silica,	46
Alumina,	14.5
Carbonate of lime,	28
Sulphate of lime,	6.5
Oxide of iron,	3
Water,	2
	100.0

Localities, &c.—This mineral is found in Persia, Natolia, and China, and it is supposed that its repository is among granite. It has been found also in Siberia, near the lake Baikal, where it forms a vein along with garnets, feldspar, and pyrites. It is frequently mixed with pyrites, and a grayish white feldspar.

Uses.—This stone, when it is of a fine blue colour, and free from white spots, is held in great estimation for various ornamental purposes; but it derives its greatest value from its use in painting. The colour which it furnishes is called *ultramarine*. To prepare it, the stone is first calcined, and then reduced to an impalpable powder, which is mixed with a paste composed of resinous matters, of wax and linseed oil. From this mixture a powder is obtained by washing, which being dried affords the colouring matter. This colour, when used in painting, is not susceptible of change.

53. Species. HYDRARGILLITE.

Wavellite of Dr Babington and others.

Exter. Char.—This mineral is found crystallized. The crystals are very minute, and are attached to quartz, in tufts or bundles, which diverge from a common centre. It is also found closely compacted together, in the form of mammillary protuberances of the size of small peas, and adhering to each other. The crystals, when magnified, appear to be four-sided, and, when broken, the section seems to be rhomboidal. The crystals have sometimes the appearance of fine down, and sometimes are of the size of a hair. Lustre silky.

The colour is white, with a shade of gray or green; usually opaque, and sometimes semitransparent. The texture is loose; but the small fragments are so hard as to scratch agate. Spec. grav. 2.25 to 2.70.

Chem. Char.—Infusible before the blow-pipe; but the crystals, exposed suddenly to strong heat, decrepitate.

Constituent Parts.

	Davy, Nich. Jour. xi. 153.	Gregor. ibid. xiii. 247.
Alumina,	70.	58.70
Silica,	—	6.12
Lime,	1.4	.37
Oxide of iron,	—	.19
Water,	26.2	30.75
A portion of fluoric acid,		
	97.6	96.13

Localities, &c.—This mineral was first discovered by Dr Wavell, in a quarry near Barnstaple. Mr Hatchett found it, in 1796, filling the cavities and veins of a soft argillaceous schistus. It has since been found in Stenna-Gwyn mine, in the parish of St Stephen's, Cornwall, where it is accompanied with sulphuret of tin, copper, and iron.

54. Species. ANDALUSITE.

Adamantine Spar, Kirwan, i. 337. *Spath Adamantin*, Bournon, Jour. de Phys. 1789. *Feldspath Apyre*, Hauy, iv. 362.

Exter. Char.—This mineral is found massive, and crystallized in rectangular four-sided prisms, the summits of which are obliterated. Lustre weakly shining and resinous. Longitudinal fracture foliated. Cross fracture a little splintery. Colour reddish brown or violet; translucent at the edges. Very hard; scratches quartz, and sometimes even spinelle. Difficultly frangible. Spec. grav. 3.165.

Chem. Char.—Infusible before the blow-pipe.

Localities, &c.—This mineral was first discovered by Bournon in the granitic rocks of Forez, where it occupies a vein of common feldspar. It has been found also in Spain, where it enters into the composition of a granite. It is also met with in Aberdeenshire. When first discovered it was supposed to be a variety of adamantine spar, or corundum; but its inferior spec. grav. and the difference in the structure of its crystals, afford sufficient characteristic differences.

55. Species. FELDSPAR.

This species is divided into the five following subspecies: 1. Adularia. 2. Labradore stone. 3. Common feldspar. 4. Compact feldspar. 5. Hollow spar.

Subspecies 1. ADULARIA.

Moonstone, Kirwan, i. 322. *L'Adulaire*, Brochant, i. 371. *Feldspath Nacré*, Hauy, ii. 606.

Exter. Char.—This mineral is found massive or crystallized. The forms of its crystals are, 1. A four-sided rhomboidal prism. 2. A perfect rhomb, more or less oblique. 3. A rectangular four-sided table, with oblique terminal faces. 4. A six-sided prism. 5. A six-sided table. Surface of the crystals smooth or longitudinally streaked. Lustre shining or resplendent. Internal lustre resplendent, vitreous, or pearly. Fracture foliated. Cleavage double. Fragments rhomboidal.

Colour yellowish, greenish, or milk-white: is sometimes

Classification.

Classification.

times chatoyant. Is always translucent; sometimes semitransparent. Hard; scratches common feldspar. Brittle, and easily frangible. Spec. grav. 2.500 to 2.561.

Chem. Char.—Adularia before the blow-pipe cracks and splits, and then melts into a white glass.

Constituent Parts.

	Vauquelin.	Westrumb.
Silica,	64	62.50
Alumina,	20	17.50
Lime,	2	6.50
Potash,	14	—
Magnesia,	–	6.
Oxide of iron,	–	1.40
Sulphate of barytes,	–	2.
Water,	–	.25
Loss,	–	3.85
	100	100.00

Localities, &c.—This mineral was first found by Pini in one of the summits of St Gothard in Switzerland; this summit is called Adula, and from this it takes its name. It is said that it forms particular beds, interposed between micaceous schistus and gneis. It is accompanied with quartz, mica, and common feldspar.

Subspecies 2. Labradore Stone.

Id. Kirwan, i. 324. *La Pierre de Labrador*, Brochant, i. 369. *Feldspath Opalin*, Hauy, ii. 607.

Exter. Char.—This mineral is found massive, and in rounded pieces. Internal lustre shining, sometimes resplendent; pearly, or vitreous. Fracture perfectly foliated, with a double cleavage.

Colour most commonly dark or deep ash gray; but by varying its position it reflects different colours, as blue, green, yellow, brown, and red; and these colours exhibit stripes, spots, and dots. It is strongly translucent. Spec. grav. 2.6 to 2.7.

Chem. Char.—Before the blow-pipe fusible into a white enamel.

Constituent Parts.	Bindheim.
Silica,	69.5
Alumina,	13.6
Sulphate of lime,	12.
Oxide of copper,	.7
Oxide of iron,	.3
Loss,	3.90
	100.00

Localities, &c.—This stone was first brought from the island of St Paul, near the coast of Labradore, whence its name. It has been since found in Bohemia, and near the lake Baikal in Siberia. It is rarely found in its native repository, but it is supposed to belong to primitive rock; for it is accompanied with schorl, mica, and hornblende.

Uses.—The brilliancy of its colours, and particularly its chatoyant property, have brought it into use in jewellery.

Siliceous genus.

Subspecies 3. Common Feldspar.

Id. Kirwan, i. 316. *Le Feldspath Commun*, Brochant, i. 362. *Feldspath*, Hauy, ii. 590.

Exter. Char.—Feldspar is found massive, disseminated, in rounded pieces, or crystallized. Its forms are, 1. A broad six-sided prism with unequal angles, terminated at each extremity by an obtuse bevelment, whose faces are placed on the two lateral edges. 2. A four-sided rhomboidal prism. 3. A four-sided rectangular prism, having the lateral edges sometimes truncated; and, 4. A six-sided table. Double crystals are sometimes met with. Lustre shining; internal lustre also shining; sometimes resplendent, vitreous or pearly. Fracture perfectly foliated; fragments rhomboidal.

Colours milk-white, yellowish, grayish, reddish, and greenish. Translucent; scratches glass; brittle, and easily frangible. Spec. grav. 2.437 to 2.704.

Chem. Char.—Before the blow-pipe melts into a white glass.

Constituent Parts.

	Vauquelin.	Kirwan.	Chenevix.
Silica,	62.83	67	64.
Alumina,	17.2	14	24.
Lime,	3.	–	6.25
Oxide of iron,	1.	–	2.
Potash,	13.	–	–
Barytes,	–	11	–
Magnesia,	–	8	–.
Loss,	3.15	–	3.75
	100.00	100	100.00

Localities, &c.—Feldspar is one of the most common substances, and the most universally distributed in nature. It does not exist, however, in large masses. It forms one of the component parts of granite, gneis, syenite and porphyry.

When exposed to the action of the air, it is very liable to decomposition, and then it is converted into a white earthy mass, which is employed in the manufacture of porcelain. This is the kaolin of the Chinese.

Subspecies 4. Compact Feldspar.

Continuous Feldspar. Kirw. i. 323. *Le Feldspath Compacte*, Broch. i. 367. *Feldspath Compacte Bleu*, Hauy, ii. 605.

Exter. Char.—This variety is found massive, and also in rounded pieces. Lustre weakly shining, or only glimmering. Fracture imperfectly foliated, sometimes splintery. Fragments not very sharp edged.

Colour bluish white, greenish or yellowish; translucent, but sometimes only at the edges. Streak white; is scratched by quartz.

Chem. Char.—Fusible before the blow-pipe.

Localities, &c.—Compact feldspar is found in Saxony, and in the Tyrol. It is not uncommon in Scotland, as in the Grampian mountains, and on the Pentland hills in the neighbourhood of Edinburgh. The crystals of feldspar observed in antique green porphyry, are supposed to belong to this variety.

Subspecies 5. HOLLOW SPAR, or *Chiastolite*.

Macle, Broch. ii. 514. *Id.* Hauy, iii. 267.

Essen. Char.—Divisions parallel to the faces of a prism, slightly rhomboidal. A black substance surrounded by another of a whitish colour.

Exter. Char.—This mineral has been found only crystallized in four-sided, nearly rectangular prisms. The summit is always broken, by which the arrangement of the two substances is observed. The white part is the outermost; the black matter forms in the centre a small prism, whose sides correspond with those of the outer crystal. From the angles of the central prism proceed four narrow lines, which extend to each of the angles of the outer prism; and sometimes this black substance forms at the extremity of these lines, or in the angles of the large prism, a similar small prism of black matter. The black matter is an argillaceous schistus, similar to the repository of the crystals. The white part is sometimes weakly shining; internal lustre glimmering, resinous. The black part is nearly dull. Fracture foliated; the black part earthy.

The colour of the white part, yellowish, or grayish white; that of the black part, grayish, or bluish black. Opaque, or translucent. Semihard: scratching glass when foliated. Streak white. Brittle; not very frangible. Spec. grav. 2.944. Communicates to sealing wax, negative electricity by friction.

Chem. Char.—Before the blow-pipe, the white part melts into a whiter glass; the black part into a black glass.

Localities, &c.—This mineral has been found in Brittany in France, imbedded in argillaceous schistus; in the Pyrenees, in a similar rock, lying immediately on granite, near St Jacques de Compostella in Spain; and in the mountains of Cumberland, also imbedded in argillaceous schistus.

The name *chiastolite* is derived from the appearance of the section of the crystal, which is supposed to have some resemblance to the Greek letter χ.

56. Species. SCAPOLITE.

Scapolithe, Brochant, ii. 526. *Id.* Hauy, iv. 493. *Rapidolithe*, Abilgaard.

Exter. Char.—This mineral has been found massive, but most frequently crystallized in rectangular, four-sided prisms, having the lateral edges truncated. The crystals are small, sometimes acicular, commonly elongated and aggregated. Their surface is longitudinally streaked and glimmering. Internal lustre weakly shining, vitreous or resinous. Fracture foliated.

Colour grayish white; translucent, or rarely transparent. Scratches glass, and is brittle. Spec. grav. 3.68 to 3.70.

Chem. Char.—Froths up before the blow-pipe, and melts into a white enamel.

Localities, &c.—This mineral has been found in the mines of iron ore near Arendal in Norway. The crystals are mixed with mica and calcareous spar.

57. Species. ARCTIZITE.

Wernerite, Hauy, iii. 119. *Id.* Brochant, ii. 529.

Essen. Char.—Spec. grav. 3.6. Phosphorescent by heat, but not by percussion.

Exter. Char.—This mineral is found massive, or crystallized in four-sided rectangular prisms, terminated by an obtuse four-sided pyramid. The lateral edges are truncated, so that the prism appears to be eight-sided. Crystals small; lustre resplendent, sometimes weakly shining, and pearly or resinous. Fracture foliated. Folia curved in two directions.

Colour between pistachio green and isabella yellow. Translucent. Scratches glass, and strikes fire with steel. The powder thrown on hot coals phosphoresces in the dark.

Chem. Char.—Before the blow-pipe it froths up, and easily melts into an imperfect white, and opaque enamel. Insoluble in nitric acid.

Localities, &c.—This mineral is found in the iron mines of Northo and Ulrica in Sweden. Bouoen near Arendal in Norway, and at Campo Longo in Switzerland.

58. Species. DIASPORE.

Id. Brochant, ii. 507. *Id.* Hauy, iv. 358.

Exter. Char.—This mineral is of a gray colour. Lustre shining, pearly. Fracture foliated, with the folia a little curved; separates into rhomboids, with angles about 130° and 50°; scratches glass. Spec. grav. 3.432.

Chem. Char.—A fragment of this stone heated for a little in the flame of a candle decrepitates and disperses in all directions; from this property is obtained its name, which signifies *to disperse*. Heated in a close crucible to prevent the fragments from flying off, they were reduced to white shining particles, somewhat resembling boracic acid.

Constituent Parts.	Vauquelin.
Alumina,	80
Oxide of iron,	3
Water,	17
	100

Localities, &c.—The repository of this mineral is unknown. It was connected with an argillaceous ochrey rock.

This mineral approaches nearly to hydrargillite or wavellite, described above, in its constituent parts; but the proportions and some of the external characters are different.

59. Species. SPODUMENE.

Id. D'Andrada, Jour. de Phys. an 8. p. 240. *Triphane*, Hauy, iv. 407. *Id.* Brochant, ii. 528.

Exter. Char.—This mineral is found in small masses, which present some appearances of crystallization. Luster shining, pearly. Fracture in the mass radiated, of single

Classification.

single crystals foliated and divisible in three directions, which sometimes afford an oblique angled prism of about 100° and 80°. Cross fracture dull, rough, and splintery. In larger masses the fracture is radiated. Lustre shining pearly. Scratches glass.

Colour greenish white or leek green. Translucent at the edges. Brittle. Spec. grav. 3.192 to 3.218.

Chem. Char.—Before the blow-pipe it separates at first into small yellowish plates, and then melts into a grayish white transparent glass.

Constituent Parts.	Vauquelin.
Silica,	56.5
Alumina,	24
Lime,	5
Oxide of iron,	5
Loss,	9.5
	100.0

Localities, &c.—This mineral has been found in the mines of Utoe near Dalero in Sweden. Its repository seems to be a vein, where it is accompanied with quartz and black mica.

The name triphane has been given to this mineral by Hauy from its peculiar three-fold natural divisions. It received the name spodumene, which signifies *covered with ashes* from D'Andrada.

60. Species. Meionite.

Id. Hauy, ii. 586. *Id.* Brochant, ii. 519.

Essen. Char.—Divisible parallel to the faces of a prism with square bases. Easily fusible into a spongy white glass.

Exter. Char.—It is found crystallized in four-sided rectangular prisms whose lateral edges are always truncated. It is terminated by an obtuse four-sided pyramid set on the lateral edges. Sometimes the lateral edges are doubly truncated, thus forming a sixteen-sided prism. The crystals are small, adhering laterally and arranged in rows to the matrix. Lustre shining, vitreous. Longitudinal fracture foliated, and parallel to the four faces of the prism. Cross fracture slightly conchoidal.

Colour grayish white. Semi-transparent. Scratches glass.

Chem. Char.—Melts very easily before the blow-pipe with considerable intumescence accompanied with a hissing noise.

Localities, &c.—This mineral has only been found on Vesuvius near Mount Somma. The crystals are usually attached to fragments of foliated limestone.

61. Species. Sommite.

Nepheline, Hauy, iii. 186. *Id.* Brochant, ii. 522.

Essen. Char.—Divisible parallel to the sides and bases of a regular six-sided prism. With difficulty scratches glass.

Exter. Char.—This mineral is found disseminated in grains or in small crystals, which are commonly perfect six-sided prisms. The lateral faces are smooth and shining with a vitreous lustre. Longitudinal fracture foliated. Cross fracture conchoidal and shining. Colour grayish white. Translucent, rarely semitransparent. The sharp points scratch glass, the others leave only a white trace. Easily frangible. Specific gravity 3.2441. Siliceous genus

Chem. Char.—Fusible into a glass by long continued heat. Becomes opake in nitric acid, hence the name *nepheline*, signifying *cloudy*, given to it by Hauy.

Constituent Parts.	Vauquelin.
Silica,	46
Alumina,	49
Lime,	2
Oxide of iron,	1
Loss,	2
	100

Localities, &c.—This mineral is found lining the cavities of rocks on Mount Somma, from whence its name *sommite*. It is accompanied with vesuvian and black schorl, all which are supposed by some to be ejected matters from Vesuvius.

62. Species. Ichthyophthalmite.

Id. D'Andrada. *Ichthyophthalme*, Brochant, ii. 552. *Apophyllite*, Hauy. *Id.* Brongniart, i. 385.

Exter. Char.—This mineral is found massive, and crystallized in rhomboids which approach nearly to the cube; in thick six-sided tables, and in rectangular four-sided tables, with truncated edges. Lustre shining, pearly. Fracture foliated; cleavage single; cross fracture fine grained uneven, and weakly shining.

Colour yellowish or greenish white; translucent or semitransparent. Scratches glass; not easily frangible. Spec. grav. 2.46.

Chem. Char.—Exposed to the blow-pipe, is with difficulty reduced to a white enamel. In nitric and muriatic acids it forms a jelly.

Constituent Parts.	Foureroy and Vauquelin.
Silica,	51
Lime,	28
Potash,	4
Water,	17
	100

Localities, &c.—This mineral is found in the iron mine of Utoe in Sweden, imbedded in a violet-coloured limestone, and accompanied with greenish hornblende and oxide of iron.

IV. ARGILLACEOUS Genus.

1. Species. Native Alumina.

Native Argil, Kirw. i. 175. *L'Alumine Pure*, Brochant, i. 318.

Exter Char.—This mineral is found in kidney-form masses; it has no lustre; fracture earthy; fragments blunt edged.

Colours snow or yellowish white; opaque; stains a little; tender or friable; adheres a little to the tongue, feels meagre; gives out an earthy smell when breathed on. Spec. grav. 1.305 to 1.66.

Chem.

Argillaceous genus.

Chem. Char.—Before the blow-pipe is absolutely infusible, but dissolves almost entirely in acids.

Constituent Parts.	Fourcroy.
Alumina,	45
Sulphate of lime,	24
Water,	27
Lime and silica,	4
	100

But according to the analysis of others, it is composed almost entirely of pure alumina, mixed only with a small proportion of lime and silica.

Localities, &c.—It is found at Halle in Saxony, in part of the garden belonging to the college, immediately under the soil; but being only in small quantity, and in the neighbourhood of a large laboratory, has led to the supposition that it is an artificial production. It is said that it has been also found at Magdeburg in Lower Saxony, in Silesia, near Verona, and in England.

2. Species. Porcelain Earth.

Porcelain Clay, Kirw. i. 178. *La Terra Porcelaine*, Brochant, i. 320. *Argile Kaolin, et Feldspath Argilliforme*, Hauy, ii. 616.

Exter. Char.—This mineral is found massive, or disseminated; has no lustre; stains strongly; has little coherence; adheres a little to the tongue.

Colour reddish, yellowish, or grayish white.

Chem. Char.—Infusible in the strongest heat of a furnace.

Constituent Parts.	Vauquelin.	
Silica,	55.	71.15
Alumina,	27.	15.86
Lime,	2.	1.92
Oxide of iron,	.5	
Water	14.	6.73
Loss,	1.5	4.34
	100.0	100.00

Localities, &c.—This mineral is found in considerable abundance in beds and veins, in granite and gneis, especially when the proportion of feldspar is considerable. It abounds in China and Japan, where it is known by the name of kaolin; in Bohemia, Saxony, Denmark, and particularly in many places of France, as at Limoges and Bayonne, and in Cornwall in England. In many cases it seems to be owing to the decomposition of granite.

Uses.—Porcelain earth, as its name imports, is employed either as it is found native, or mixed in certain proportions with other earths, in the manufacture of porcelain. That from Limoges in France is employed without any addition.

3. Species. Common Clay.

This species is divided into five subspecies: 1. loam; 2. pipe clay; 3. potters clay; 4. variegated clay; and, 5. slaty clay.

Classification.

Subspecies 1. Loam.

Exter Char.—This mineral is found massive and in great abundance; has no lustre; fracture uneven or fine earthy; fragments very blunt-edged; has little coherence; stains.

Colour yellowish-gray, or spotted with yellow and brown, feels somewhat greasy, and adheres strongly to the tongue.

Localities, &c.—Loam is found in great abundance every where, and perhaps it ought to be considered as a mixture of different substances, rather than as a simple mineral.

Subspecies 2. Pipe Clay.

Exter. Char.—This variety is found in great masses; has scarcely any lustre; fracture fine earthy, or fine grained uneven; fragments sharp-edged; has some coherence.

Colour grayish or yellowish white; streak shining; feels greasy, adheres strongly to the tongue, and is easily frangible.

Localities, &c.—It is very abundant in most countries, and is usually found in alluvial land.

Subspecies 3. Potters Clay.

Id. Kirw. i. 180. *Argile à Potier*, Brochant, i. 322.

Exter. Char.—This variety is also found massive, and in great abundance. It is intermediate between solid and friable; has no lustre; fracture fine grained earthy, sometimes coarse grained uneven; fragments blunt-edged.

Colour yellowish, greenish, or grayish white; sometimes reddish or ochrey yellow of various shades. It is opaque, stains a little; streak a little shining; very brittle, and easily frangible; is somewhat ductile; adheres a little to the tongue, and feels greasy.

Chem. Char.—Is differently affected by the blow-pipe, according to the proportion of the different substances of which it is composed; but in general is difficult of fusion. Effervesces with acids when the proportion of lime is considerable.

Constituent Parts.	Vauquelin.
Silica,	43·5
Alumina,	33·2
Lime,	3·5
Oxide of iron,	1.
Water,	18.
Loss,	.8
	100,0

The proportions of silica and lime vary considerably; the silica is very often the predominant ingredient. Kirwin examined a potters clay, in which he found 63 parts of silica.

Localities, &c.—Potters clay is found in great abundance in most countries, and in similar situations with the former. It often forms thick beds in alluvial land, alternating with beds of sand.

Subspecies 4. Variegated Clay.

Exter. Char.—This mineral is found massive. Has

an

Classification.

an earthy fracture, a shining streak, and is soft or friable.

The colour is white, red, or yellow, and these different colours are sometimes in stripes, veins and spots. Adheres a little to the tongue, and feels somewhat greasy. It is sectile and light.

As this variety of clay forms with water a less tenacious mass than some of the other varieties, it probably contains a greater proportion of siliceous earth.

Localities, &c.—This mineral is found in Upper Lusatia.

Subspecies 5. Slaty Clay.

Slate Clay, Shale, Kirwan, i. 182. *L'Argile Schisteuse*, Brochant, i. 327. *Argile Schisteuse Impressionée*, Hauy, iv. 448.

Exter Char.—This subspecies is found massive; internally dull, when free from mica; fracture slaty or earthy; fragments in tables.

Colour grayish, yellowish, or blackish, sometimes reddish or brownish; opaque; soft, sectile, and easily frangible. Adheres to the tongue; feels meagre. Sp. grav. 2.6 to 2.68.

Localities, &c.—Usually accompanies coal, so that it abounds in all coal countries. It is sometimes mixed with sand, mica, and iron pyrites. It is known in this country under the name of *shale*, and in Scotland particularly by that of *till*, or described under the more general denomination of one of the coal metals. Slaty clay is still farther distinguished by impressions of ferns, reeds, or grasses. When it is of a black colour, it seems to be owing to a greater proportion of coaly matter.

4. Species. Clay Stone, or Indurated Clay.

Indurated Clay, Kirwan, i. 181. *L'Argile Endurcie*, Brochant, i. 325.

Exter. Char.—Indurated clay is always found massive; it is dull; fracture compact, or fine earthy; but sometimes splintery or even, and also sometimes slaty. Fragments more or less sharp edged, and sometimes in tables.

Colour usually bluish, yellowish, or greenish gray, and sometimes pearl gray, grayish red, whitish, and brownish. These colours are often mixed, and are arranged in spots and stripes. Opaque, soft, rather brittle; easily frangible; adheres slightly to the tongue; feels greasy. Spec. grav. inconsiderable. Gradually falls to pieces in the water, or crumbles into powder. Has but little ductility.

Localities, &c.—Indurated clay is very common. It is found in veins, and sometimes in very extensive beds. It constitutes the basis of many porphyries, especially in Saxony, where it is abundant. It is found in many parts of Scotland, as on the Pentland hills in the neighbourhood of Edinburgh.

Stourbridge clay, according to Mr Kirwan, may be included under this variety. It is of a gray colour; does not adhere to the tongue; part is soon diffused in water, and another part falls into powder. Mr Kirwan found it to contain 12.5 of moisture, 12 of a coarse white sand, 30 of a fine brownish sand, and even the remaining or argillaceous part was not entirely freed from sand but by boiling in acids.

Argillaceous genus.

5. Species. Adhesive Slate.

Le Schiste à Polir, Brochant i. 376. *Schiste à Polir*, Hauy, iv. 449. *Polishing Slate*, Klaproth, i. 455. Analyt. Ess. Transl.

Exter. Char.—This mineral is found massive; is always internally dull; has a slaty or fine earthy fracture; fragments slaty or in tables.

Colour clear gray, whitish or reddish; opaque or slightly translucent at the edges; gives a shining streak; is sectile, soft, and very easily frangible; adheres strongly to the tongue: feels meagre. Specific gravity 2.08.

Chem. Char.—Immersed in water, adhesive slate absorbs it greedily, air bubbles being rapidly disengaged and with noise; but does not become tenacious. When reduced to powder and calcined, it loses about one-fifth of its weight. Exposed to strong heat, it is converted into a dark gray or yellowish and porous slag. (Brochant).

Constituent Parts.	Klaproth.	
Silica,	66.5	62.5
Alumina,	1.	.7
Magnesia,	1.5	8.
Lime,	1.25	.3
Oxide of iron,	2.5	4.
Carbone,	22.	.7
Water and air,	19.	22.
Loss,	2.25	1.8
	100.00	100.0

Localities, &c.—Adhesive slate forms considerable beds at Menil-Montant near Paris. In these beds menilite already described is found.

6. Species. Polishing Slate.

Le Polierschiefer, Brochant, i. 376.

Exter. Char.—This mineral is found massive; internally it is dull. Fracture slaty, but in some directions earthy. Fragments slaty or in tables.

Colour yellowish gray or white; and different colours appear disposed in stripes; is soft; adheres to the tongue; feels meagre, and is rather light.

Localities, &c.—This mineral has been found only, it is said, in Bohemia, near pseudo volcanoes, and it is supposed, that it is nothing more than indurated coal-ashes. It approaches so near in the characters that are given of it to the following, that it might be included under the same species, or considered as a variety of it.

7. Species. Tripoli.

Id. Kirw. ii. 202. *Le Tripoli*, Broch. i. 379. *Quartz Aluminifere Tripoléen*, Hauy, iv. 467.

Exter. Char.—This mineral is found massive; is dull internally; has a coarse earthy fracture, sometimes slaty; fragments blunt-edged.

Colour yellowish gray, and sometimes brownish red. Is soft and somewhat friable; meagre to the feel, but does not adhere to the tongue.

Chem. Char.—It is almost infusible before the blow-pipe.

Argillaceous genus.

pipe. It melts with borax without frothing up. It does not form a paste with water.

Constituent Parts.	Haasse.
Silica,	90
Alumina,	7
Oxide of iron,	3
	100

Localities, &c.—This substance was formerly brought to Europe from Tripoli; hence the name; but it has since been found in many other places, as in Bavaria, Saxony, and Bohemia; in Russia and in England. It is found in the neighbourhood of basalts, sometimes forming veins; at Potschappel it is disposed in beds among the strata of coal, and near those places where strata of coal have been on fire.

Uses.—Tripoli is employed in polishing metals, precious stones, and glasses for optical instruments.

8. Species. Floatstone.

Exter. Char.—This mineral has been found in tuberose porous masses; it is dull, has an earthy fracture, and blunt-edged fragments.

The colour is yellowish gray or grayish white. It is soft and brittle; rough to the feel, and gives out a creaking sound. It is very light, from which it has its it name.

Localities, &c.—Has been only found at St Omers near Paris.

9. Species. Alum Stone.

La Pierre Alumineuse, Broch. i. 381.

Exter. Char.—This stone is found massive; is generally dull, rarely a little glimmering; fracture uneven, sometimes splintery; fragments not very sharp-edged.

Colour grayish or yellowish white: it is soft, and sometimes semihard; stains a little, and adheres to the tongue.

Chem. Char.—This mineral does not effervesce with acids; but after being heated and dissolved in water, it affords alum. According to Bergman it contains 43 of sulphur, 35 of alumina, and 22 of silica; but the following is the result of Vauquelin's analysis.

Constituent Parts.	
Alumina,	43.92
Silica,	24.
Sulphureous acid,	25.
Sulphate of potash,	3.08
Water,	4
	100.00

Localities, &c.—This mineral has been long known under the name of the *stone of Tolfa*, from the name of the place where it is found near Rome, and where it forms a mountain which is traversed by veins of whitish gray quartz. It is from this stone that the Roman alum, so celebrated in commerce, is manufactured; and it has been supposed that the excellence of the alum is owing to the mineral containing within itself all the ingredients necessary in the formation of that triple salt.

Classification

10. Species. Aluminous Schistus.

This is divided into two varieties or subspecies; 1. common; and, 2. shining.

Subspecies 1. Common Aluminous Schistus.

Le Schiste Alumineux, Broch. i. 386.

Exter. Char.—This mineral is found in masses, which often contain pieces of a globular form. It is sometimes glimmering, amd sometimes dull; fracture commonly slaty, and sometimes a little earthy; fragmeuts in tables; streak the same as the colour of the mineral, a little shining.

Colour grayish black or brownish; is soft; meagre to the feel, and easily frangible.

Chem. Char.—When exposed to the air for some time it separates and yields alum by lixiviation.

Localities, &c.—Aluminous schistus is abundant in Saxony, Bohemia, France, England, and some parts of Scotland. It is disposed in beds among stratiform rocks, and in transition rocks, and it is often traversed by veins of quartz. Being mixed with pyrites, the decomposition is thus promoted when exposed to the air.

Uses.—This mineral is dug out for the purpose of extracting alum, first by exposing it to the air or heat, and then by lixiviation.

Subspecies. 1. Shining Aluminous Schistus.

Le Schiste Alumineux Eclatant, Broch. i. 388.

Exter. Char.—This mineral approaches very nearly to the former in most of its characters, but in the direction of its principal fracture the external surface is smooth; lustre shining, or resplendent, resinous, and even somewhat metallic; in the opposite directions it is dull. Fracture commonly slaty, and somewhat curved; fragments in tables.

Colour intermediate between bluish and grayish black, and sometimes iron black. Colours in the rents irideseent.

In other characters and circumstances it resembles the former.

11. Species. Bituminous Schistus.

Le Schiste Bitumineux, Broch. i. 289. *Bituminous Shale*, Kirw. 183.

Exter. Char.—This mineral is found massive; lustre glimmering; fracture most commonly thin, rarely thick; fragments in the form of tables, sometimes trapezoidal.

Colour brownish black, sometimes gray or blackish brown; soft and easily frangible; adheres slightly to the tongue; streak shining; feels greasy.

Chem. Char.—When placed on burning coals it gives out a pale flame with a sulphureous odour, becomes white, and loses a good deal of its weight.

Localities, &c.—This mineral is peculiar to coal countries, which it always accompanies, and alternates with

Classification.

with slaty clay and coal. It is not unfrequent in Bohemia, Poland, England, and Scotland.

12. Species. Drawing Slate.

Black Chalk, Kirwan, i. 195. *Le Schiste à Dessiner*, Broch. i. 391. *Argile Schisteuse Graphique*, Hauy, iv. 447.

Exter. Char.—This mineral is found massive, usually dull; but in the direction of the principal fracture a little glimmering; fracture in certain directions curved slaty; in others fine grained earthy; fragments splintery or tabular.

Colour grayish or bluish black; opaque; stains black; soft; meagre to the feel.

Chem. Char.—Before the blow-pipe it becomes covered with a kind of varnish.

Constituent Parts.	Wiegleb.
Silica,	64.50
Alumina,	11.25
Carbone,	11
Oxide of iron,	2.75
Water,	7.50
Loss,	3
	100.00

Localities, &c.—Drawing slate frequently accompanies aluminous schistus. It forms along with it beds which are subordinate to clay slate. It is found in Italy, where it is an object of commerce. It is also found in Spain, France, and some parts of Scotland.

Uses.—As its name indicates, it is employed like black chalk in drawing.

13. Species. Whet Slate.

Novaculite, Kirw. i. 238. *Le Schiste à Aiguiser*, Brochant, i. 393. *Argile Schisteuse Novaculaire*, Hauy, iv. 448.

Exter. Char.—This mineral is found massive; is scarcely glimmering; fracture in large masses slaty, in small pieces splintery; fragments tabular.

Colour commonly greenish gray, or smoke gray. Sometimes mountain green: translucent at the edges: semihard, but varying between hard and soft; rather easily frangible; streak grayish white; feels greasy; does not adhere to the tongue. Specific gravity 2.722.

Chem. Char.—Does not effervesce with acids, and is infusible before the blow-pipe.

Localities, &c.—Whet slate is found in primitive mountains, where it forms beds which are subordinate to clay slate. It was originally brought from the Levant; but has since been discovered in Bohemia, Saxony, in Bayreuth, where it is wrought, and in Siberia. An efflorescence has been observed on the surface, which is found to be sulphate of magnesia; from which it is naturally supposed that the base of that salt forms one of its constituent parts.

Uses.—Whet slate, as its name imports, is cut and polished for the purpose of sharpening knives and other instruments; and, reduced to powder, is employed in polishing steel.

Argillaceous genus.

14. Species. Clay Slate.

Argillite, or *Argillaceous Schistus*, or *Slate*, Kirwan, i. 234. *Le Schiste Argilleux*, Brochant, i. 395. *Argile Schisteuse Tegulaire*, Hauy, iv. 447.

Exter. Char.—Clay slate is found massive, or disseminated, or in rounded pieces; internally it is a little shining or glimmering; rarely dull; the more the structure is foliated, the greater is its lustre. Lustre sometimes silky, pearly, or semimetallic. Fracture more or less slaty, sometimes curved and waved, sometimes earthy or splintery; fragments tabular, rarely splintery; sometimes cubic or rhomboidal.

Colour chiefly gray of various shades; but sometimes it is reddish, brownish, or yellowish, or reddish brown. Different colours are so disposed as to appear striped, waved, spotted, or dendritic. It is in general soft; sometimes semihard, sectile, and easily frangible. Gives a grayish white streak; feels greasy. Spec. grav. 2.67 to 2.88.

According to Kirwan, clay slate is composed of silica, alumina, lime, magnesia, and iron, with some bituminous particles.

Localities, &c.—Clay slate belongs equally to the primitive, transition, and stratiform rocks, and frequently forms entire mountains. Primitive clay slate is sometimes mixed with quartz, mica, hornblende, garnets, limestone, pyrites, cinnabar as at Idria; in general it abounds with metallic ores, either in veins or in beds.

Clay slate is very abundant in most countries; it is not unfrequent in many parts of Scotland; but the slate of Easdale, and the contiguous islands on the west coast, has long maintained a decided superiority and preference to all others in this country.

Uses.—Clay slate is in extensive use for covering houses, and then it is known in this country by the single word *slate*. It is also employed in large plates for writing on, or tracing characters that are afterwards to be effaced.

15. Species. Lepidolite.

Id. Kirwan, i. 208. *Id.* Hauy, iv. 375. *La Lepidolithe*, Brochant, i. 399.

Exter. Char.—Lepidolite is found massive, and disseminated in small plates, which might be taken for mica. It is usually glimmering, rarely shining. Lustre semimetallic. Fracture fine grained uneven, rarely foliated. Fragments blunt edged.

Colour lilac blue, grayish and reddish brown; translucent. Semihard; sometimes soft; easily frangible; and feels meagre. It is easily scraped with the knife; but is with difficulty reduced to powder by trituration. The powder rubbed between the fingers has a greasy feel. Spec. grav. 2.816 to 2.854.

Chem. Char.—Froths up under the blow-pipe, and melts into a transparent colourless globule; but with the addition of a little nitre it becomes violet.

Argillaceous genus.

Constituent Parts.

	Klaproth.	Vauquelin.
Silica,	54·5	54
Alumina,	38.25	20
Potash,	4·	18
Fluate of lime,	–	4
Oxide of iron and manganese,	·75	1
Water and loss,	2.5	3
	100.00	100

Localities, &c.—This mineral was first discovered in the mountain Gradisko near Rosena in Moravia, where it is found in considerable masses included in blocks of granite. It is found also in Sweden. Sometimes it is disseminated in quartz rock.

The name, from λεπις, "a scale," is derived from its scaly structure. Lepidolite was at first taken for fluate of lime or zeolite. A red coloured variety of schorlite was also supposed to be crystallized lepidolite.

16. Species. Mica.

Id. Kirw. i. 21. *Id.* Broch, i. 402. *Id.* Hauy, iii. 208.

Exter. Char.—Mica is most commonly disseminated in thin tables, rarely massive or crystallized. The primitive form of its crystals is a rectangular prism, whose bases are rhombs with angles of 120° and 60°; the integrant molecule is the same. The usual forms of its crystals are, a six-sided table with equal angles, sometimes very thick, which produces a six-sided prism, and the want of two of the faces produces the table with four rhomboidal faces; but the most common form of mica is in thin plates or scales of no determinate figure. The lateral faces of the basis of the tables are smooth and resplendent; lustre metallic; fracture foliated, sometimes curved or waved, and sometimes radiated; fragments in the form of plates.

Colour usually gray, ash, yellowish, greenish, and blackish gray; in thin plates semitransparent, or even transparent; otherwise, only translucent on the edges; semihard, very easily frangible; flexible and elastic. Spec. grav. 2.79 to 2.93.

Physical Char.—Mica rubbed on Spanish wax communicates to it negative electricity.

Chem. Char.—Before the blow-pipe it is with difficulty fusible into a whitish gray or green enamel. Black mica yields a black enamel, which is attracted by the magnet.

Constituent Parts.

	Vauquelin.	Bergman. Muscovy Glass.	Kirwan. Colourless Mica.
Silica,	50.	40	38
Alumina,	35.	45	28
Lime,	1.33		
Magnesia,	1.35	5	20
Oxide of iron,	7.	9	14
Loss,	5.32		
	100.00	100	100

Localities, &c.—Mica is one of the most common minerals, forming one of the constituent parts of granite, gneis, micaceous schistus, and other primitive rocks, and in some of them sometimes forms particular small veins. Mica also enters into the composition of stratiform rocks, as green stone, basalt, wacken. Classification.

Cat gold and cat silver are varieties of mica of a gold or silver colour, which have a considerable lustre, but inferior to that of these metals. It may be easily distinguished by the streak, which in the mica affords a whitish powder without any lustre.

Uses.—When mica is obtained in large and thin plates, it is employed as a substitute for glass, and for this purpose it has been used for windows of men of war, as on account of its elasticity it is less subject to be broken from the concussion produced by the firing of cannon.

17. Species. Pinite.

Micarelle, Kirw. i. 212. *La Pinite*, Broch. i. 456.

Exter. Char.—This mineral has been usually found crystallized in six-sided prisms, having all the lateral edges truncated, or only three alternating edges, or in four-sided rhomboidal prisms. The surfaces of the crystals smooth and a little glimmering; internally it is dull, sometimes a little shining in the cross fracture; the fracture is fine grained, uneven, or small conchoidal; fragments blunt-edged.

Colour reddish or blackish brown; opaque; the brown variety is slightly transparent; so soft as to be cut with a knife, when it becomes of a bluish black; powder bright gray; adheres a little to the tongue; feels greasy; sp. grav. 2.98.

Constituent Parts.	Klaproth.
Alumina,	63.75
Silica,	29.50
Oxide of iron,	6.75
	100.00

Localities, &c.—Pinite is found only near Schneeberg in Saxony, in the mine called *Pini*; hence its name. It is accompanied by quartz, feldspar and mica, which constitute a small grained granite.

18. Species. Potstone.

Id. Kirw. i. 155. *La Pierre Ollaire*, Broch. i. 405. *Talc Ollaire*, Hauy, iii. 257.

Exter. Char.—Potstone is found massive; internally it is dull, sometimes glimmering or a little shining, pearly; fracture curved slaty, rarely foliated or waved; fragments blunt edged, in the form of tables or scales.

Colour greenish gray, sometimes reddish or yellowish; opaque, rarely translucent on the edges; soft, sectile, and mild; feels greasy; by being breathed upon it emits the argillaceous smell. Spec. grav. 2.76 to 2.86.

Chem. Char.—Infusible before the blow-pipe; some varieties absorb a little water.

Constituent

Classification.

Constituent Parts.	Wiegleb.
Silica,	38.12
Magnesia,	38.54
Alumina,	6.66
Lime,	.41
Oxide of iron,	15.02
Fluoric acid ?	.41
Loss,	.84
	100.00

Localities, &c.—Potstone is found at Chiavenna, in the Valteline, from which the specimen above analyzed was obtained; at Como, in Switzerland, hence called *Como stone*. It is also found in Saxony, Hungary, and on the banks of Loch Fine opposite to Inverary in Scotland. Potstone forms entire beds, and is usually accompanied by serpentine, or it is in nests; it is rarely pure, but mixed with chlorite, talc, asbestus, &c.

Uses.—On account of the refractory nature of this stone, it is employed in the construction of furnaces where great heat is required; and as it may be cut or turned on the lathe, it has been formed into utensils for the kitchen, and hence the name *potstone*.

19. Species. Chlorite.

Id. Kirw. i. 147. *La Chlorite*, Broch. i. 408. *Talc Chlorite*, Hauy, iii. 257.

Chlorite is divided into four subspecies: 1. earthy; 2. common; 3. foliated; 4. schistose or slaty.

Subspecies 1. Earthy Chlorite.

Exter. Char.—This mineral is composed of small, scaly, thin, and slightly glimmering particles, cohering together, rarely in the form of powder.

Colour intermediate between mountain green and dark leek green; sometimes brownish; does not stain; feels greasy, but does not adhere to the tongue; gives an earthy smell by breathing on it.

Chem. Char.—Melts before the blow-pipe into a gray or black enamel.

Constituent Parts.	Vauquelin.
Silica,	26.
Alumina,	18.50
Magnesia,	8.
Muriate of soda,	2.
Oxide of iron,	43.
Water,	2.
Loss,	.50
	100.00

Localities, &c.—Earthy chlorite is always found in primitive mountains, forming beds which are subordinate to clay slate. It is found in Saxony, Switzerland, Savoy, and in Scotland.

Subspecies 2. Common Chlorite.

Exter. Char.—This is found massive and disseminated, or in thin superficial layers on other stones; internal lustre slightly glimmering, resinous; fracture earthy, or foliated; fragments blunt-edged; soft, sometimes semi-hard. Argillaceous genus.

Colour similar to the former, and sometimes grayish white; is opaque, easily frangible; gives a light green streak without lustre.

Constituent Parts.	Hoepfner.
Silica,	41
Magnesia,	39
Alumina,	6
Lime,	1
Oxide of iron,	10
Loss,	3
	100

Localities, &c.—Common chlorite is found in the same places with the former, and indeed it is supposed to be earthy chlorite indurated. At Altenberg in Saxony, it is mixed with pyrites of copper and arsenic, and common hornblende.

Subspecies 3. Foliated Chlorite.

Exter. Char.—This variety is found massive, disseminated, and crystallized in the form of a six-sided table somewhat elongated; several of these tables being united together, frequently form globular, kidney-form, or botryoidal groups. External lustre glimmering or weakly shining; internal shining, resinous, or pearly; fracture foliated; folia curved; cleavage simple; fragments in tables.

Colour intermediate between leek and dark green; opaque, or translucent at the edges; streak light green; is soft, sectile, easily frangible, and feels a little greasy.

Constituent Parts.	Lampadius.
Silica,	35.
Magnesia,	29.9
Alumina,	18.
Oxide of iron,	9.7
Water,	2.7
Loss,	4.7
	100.0

Localities, &c.—This mineral has been only found on St Gothard in Switzerland; it lines the sides of a vein which traverses micaceous schistus. It is accompanied by crystals of green mica, adularia, and quartz.

Brochant suggests that foliated chlorite may perhaps be nothing else than a crystallized mica.

Subspecies 4. Schistose Chlorite.

Exter. Char.—This variety is found massive; internal lustre weakly shining, sometimes shining, resinous; fracture curved slaty, sometimes waved, or a little splintery; fragments tabular.

Colour green; is soft, sectile, and easily frangible; streak light green; feels a little greasy; gives the earthy smell by breathing.

Localities, &c.—Slaty chlorite is found in Norway, Sweden, Switzerland, in different parts of Scotland, as on the banks of Loch Lomond, and in the islands of

Argillaceous genus.

Bute and Arran. Sometimes it forms very extensive beds in mountains of clay slate, to which it is subordinate; and it is frequently accompanied by garnets and magnetic iron, crystallized in octahedrons. The name is derived from the Greek word which signifies green.

20. Species. Hornblende.

This is divided into four subspecies; 1. common; 2. basaltic; 3. labradore; and, 4. schistose.

Subspecies 1. Common Hornblende.

Hornblende, Kirw. i. 163. *Hornblende Commune*, Broch. i. 415. *Amphibole*, Hauy, iii. 58.

Exter. Char.—Hornblende is found massive or disseminated, and sometimes crystallized. The forms are a four-sided prism, of which the acute opposite lateral edges are strongly truncated; a six-sided prism with four broad and two narrow faces, slightly truncated on the lateral edges; a similar six-sided prism, short, and having the extremities bevelled; an eight-sided prism, having at its extremities, a convex bevelment. Sometimes the crystals are acicular and in groups; internal lustre shining, vitreous, or pearly; fracture foliated, sometimes radiated, and sometimes fibrous; surface of the fracture longitudinally streaked; fragments sharp-edged, sometimes rhomboidal.

Colour deep black, greenish black, or greenish gray; usually opaque. The green varieties translucent at the edges. Soft or semihard; not easily frangible; streak grecnish gray; gives an earthy smell by breathing on it: sp. grav. 3.6 to 3.88.

Chem. Char.—Before the blow-pipe it melts easily into a grayish black glass.

Constituent Parts.

	Kirwan.	Hermann.
Silica,	37	37
Alumina,	22	27
Magnesia,	16	3
Lime,	2	5
Oxide of iron,	23	25
Loss,		3
	100	100

Localities, &c.—Hornblende is one of the constituent parts of primitive rocks, as in sienite; and it seems also to be an accidental substance, as in gneiss, primitive limestone, porphyries, and micaceous schistus. It is found also in masses or entire beds, as in Saxony; and is very common in most countries, as in Norway, Hungary, and Britain.

Uses.—Sometimes employed as a flux for ores of iron.

Subspecies 2. Basaltic Hornblende.

Basaltine, Kirw. i. 219. *Hornblende Basaltique*, Roch. i. 424.

Exter. Char.—This mineral is most frequently found crystallized in equal six-sided prisms, variously modified or with equal sides; having two narrow and four broad; or four narrow and two broad; or three broad and three narrow alternately. The crystals are imbedded, insulated, or grouped. Surface smooth, shining; internal lustre resplendent, in the cross fracture weakly shining, vitreous; fracture foliated; cross fracture small grained, uneven, or conchoidal. Fragments nearly rhomboidal. Classification.

Colour velvet black, and sometimes with a shade of green; opaque; streak grayish white; semihard; earthy smell by expiration. Spec. grav. 3.22 to 3.33.

Chem. Char.—Before the blow-pipe melts less easily than the preceding, into a black glass.

Constituent Parts.	Bergman.
Silica,	58
Alumina,	27
Lime,	4
Magnesia,	1
Oxide of iron,	9
Loss,	1
	100

Localities, &c.—This mineral, as its name imports, is usually found in basalt. It is also met with in wacken, and in the lava of Vesuvius. It is not uncommon in the basaltic rocks of Silesia, Saxony, and Bohemia, as well as in those of this country. As it is less liable to decomposition than the rocks which contain it, detached crystals are frequently found among decayed basalt.

Subspecies 3. Labradore Hornblende.

La Hornblende du Labrador, Broch. i. 419.

Exter. Char.—This mineral is found massive, disseminated, in rounded pieces, and very rarely crystallized in four-sided rectangular prisms. Internal lustre shining, somewhat metallic; fracture foliated, sometimes curved.

Colour blackish green, or grcenish black; sometimes bronze yellow; scarcely translucent at the edges; semihard; not difficultly frangible; streak greenish. Spec. grav. 3.38.

Localities, &c.—This mineral is found in the island of St Paul on the Labradore coast, but nothing is known of the nature of its repository.

Subspecies 4. Schistose Hornblende.

Id. Kirw. i. 222. *La Hornblende Schisteuse*, Broch. i. 428.

Exter. Char.—This variety is found massive; internal lustre weakly shining; fracture in masses slaty; in small pieces radiated, sometimes fibrous; fragments in plates.

Colour greenish, or grayish black; opaque; semihard; streak greenish gray; rather difficultly frangible; breathed on, gives the earthy smell.

Localities, &c.—Schistose hornblende forms extensive beds in primitive mountains, to which it is subordinate. It seems to be common hornblende more or less mixed with quartz. It is found in Bohemia, Norway, Sweden, in the isle of Skye, and other places of Scotland.

21. Species. Basalt.

Figurate Trap, *Trap*, *Whinstone*, &c. Kirw. i. 225. —233. *Le Basalte*, Broch. i. 430. *La Lithöide Prismatique*, Hauy, iv. 474.

Exter.

Classification.

Exter. Char.—Basalt forms entire mountains, in the neighbourhood of which it is found in rounded pieces, or in large globular masses; internally it is dull; sometimes glimmering from a mixture of hornblende; fracture uneven, sometimes fine splintery or conchoidal; fragments not very sharp-edged. It is most frequently in distinct concretions, which are prismatic or columnar, more or less regular; sometimes also in globular distinct concretions.

Colour grayish or bluish black, sometimes brownish on the surface; opaque; semihard; brittle, and very difficultly frangible; streak light ash gray; gives a ringing sound under the hammer. Spec. grav. 2.86 to 3.

Chem. Char.—Melts very easily before the blow-pipe into an opaque black glass which acts on the magnet.

Physical Char.—Many basalts affect the magnetic needle, reversing the poles when it is brought near them. This is ascribed to the great proportion of iron which enters into their composition.

Localities, &c. Basalt is not uncommon in every part of the globe, and in many places it is very abundant. It is found in regular columns in several of the Hebrides on the west coast of Scotland, as in Cannay, Eigg, the Schant isles, but particularly beautiful in Staffa. Pretty regular columns are observed also at Dunbar, and on the south-west side of Arthur's seat near Edinburgh; but the Giant's causeway and the rocks about Fairhead on the north coast of Ireland, exhibit the finest and most extensive ranges of columnar basalt in the world.

Basalt, besides being in the columnar form, is often disposed in beds and veins; both of which are very common in different places in Scotland, particularly on the western coast, and in the western islands. See Dr Millar's edition of *Williams's Mineral Kingdom*.

No subject, in geological speculation, has produced more controversial discussion than the origin of basalt; one party asserting that it is the effect of fusion, while another contends that it must have been deposited from an aqueous solution. Our limits preclude us even from barely stating the arguments which have been proposed by naturalists in support of the theories which different parties have embraced. For an account of some of them, see GEOLOGY *Index;* and for the constituent parts of basalt, and some other facts connected with its natural history, see BASALT.

Uses.—Basalt is sometimes employed as a touchstone, as a flux for ores of iron, and in the manufacture of common bottles. It is also employed for millstones. The ancients employed it in sculpture, for it would appear that some of their vases and statues were formed of it.

22. Species. WACKEN.

Id. Kirw. i. 223. *La Wakke*, Broch. i. 434.

Exter. Char.—Wacken is found massive; it is frequently vesicular, and the cavities are often filled with other minerals; internal appearance dull; fracture even or earthy; fragments rather blunt-edged.

Colour grayish green, grayish black, reddish, or brownish; opaque; streak a little shining; soft or semihard; easily frangible; feels a little greasy. Spec. grav. 2.35 to 2.89. Argillaceous genus.

Chem. Char.—Fusible like basalt.

Localities, &c.—Wacken belongs to the stratiform rocks. It contains sometimes petrified wood, and the bones of animals. It constitutes beds sometimes in the middle of basalt, but is oftener in the form of veins, and is the basis of amygdaloid, the cavities of which are filled with green earth, calcareous spar, &c. Wacken is met with in Saxony, Bohemia, Sweden, and many places of Scotland.

23. Species. PHONOLITE, or *Clinkstone.*

Id. Daubuisson, Jour. de Phys. lx. 74. *La Pierre Sonnante*, Broch. i. 437. *Klingstein* and *Porphyrschiefer* of the Germans.

Exter. Char.—This mineral is always found massive; internal lustre glimmering; fracture slaty, sometimes uneven or conchoidal; fragments sharp-edged; composed of distinct concretions, which are either in the form of tables, or are columnar, and somewhat regularly grouped together.

Colour gray, ash, greenish, or bluish gray; the colours sometimes have a dendritical appearance; opaque, or translucent at the edges; semihard, or hard; not difficultly frangible; in thin plates it emits a sound when struck with a hammer, and hence its name. Spec. grav. 2.575.

Chem. Char.—Melts before the blow-pipe into a colourless glass.

Constituent Parts.

	Klaproth.	Bergman.
Silica,	57.25	58.
Alumina,	23.5	24.5
Lime,	2.75	3.5
Oxide of iron,	3.25	4.5
———manganese,	.25	—
Soda,	8.1	6.
Water,	3.	2.
Loss,	1.9	1.5
	100.00	100.0

The stone analyzed above by Bergman, was from Puy in Velay, in France, and is considered by Dolomieu as volcanic. The other by Klaproth, is from Bohemia. Excepting the small proportion of manganese detected in the latter, the coincidence of the two analyses is very striking.

Localities, &c.—Phonolite is not uncommon in many parts of the world. It is met with in Scotland, in the island of Lamlash near Arran; and it constitutes the greater part of Traprene Law in East Lothian; in both places it is columnar.

24. Species. LAVA.

Id. Kirw. i. 400. *La Lave*, Broch. i. 440. *La Scorifice*, Hauy, iv. 497.

Exter. Char.—This mineral is generally of a porous texture, with cavities of different sizes; lustre glimmer-

in

Argillaceous genus.

ing or a little shining, vitreous; fracture imperfectly conchoidal; fragments not very sharp-edged.

Colour blackish gray, perfect black, or brownish black, sometimes greenish, and rarely white; opaque; semihard; brittle; not difficultly frangible; light.

Chem. Char.—Lava is very fusible, and yields a compact black glass.

Constituent Parts.	Bergman.
Silica,	49
Alumina,	35
Lime,	4
Oxide of iron,	12
	100

Localities, &c.—Lava being a volcanic product, is only found in the vicinity of volcanoes.

Uses.—Lavas are employed for the purposes of building; their lightness, arising from the numerous cavities, renders them proper for the construction of vaults.

25. Species. Green Earth.

Id. Kirw. i. 196. *La Terre Verte*, Brochant, i. 445. *Talc Chlorite Zographique*, Hauy, iii. 257.

Exter. Char.—Green earth is found massive, or disseminated, or in superficial crusts on balls of agate; internally it is dull; fracture earthy; fragments blunt-edged.

Colour celadon green, or blackish green; opaque; soft; feels slightly greasy; adheres a little to the tongue; streaks weakly shining.

Chem. Char.—Before the blow-pipe it becomes black, but is infusible. It is not acted on by acids, and absorbs water.

Constituent Parts.	Klaproth.
Silica,	53.
Alumina,	12.
Lime,	2.5
Magnesia,	3.5
Oxide of iron,	17.
Water,	12.
Loss,	1.
	100.00

Localities, &c.—Green earth is found at Verona, where it is wrought, and constitutes an article of commerce; and it is met with in all amygdaloid rocks.

Uses.—Green earth is employed as a colouring matter in painting.

26. Species. Lithomarga.

Id. Kirw. i. 187. *La Moelle de Pierre*, Brochant, i. 447. *Argile Lithomarge*, Hauy, iv. 444.

This is divided into two subspecies, chiefly distinguished by their cohesion. These are, 1. friable; 2. indurated.

Subspecies 1. Friable Lithomarga.

Exter. Char.—This is found massive or disseminated; is slightly glimmering; adheres strongly to the tongue; feels greasy.

Colour yellowish white, snow white, sometimes reddish; the particles have very little cohesion.

Classification.

Subspecies 2. Indurated Lithomarga.

Exter. Char.—This is also found massive or disseminated; is dull; has a fine grained earthy fracture, sometimes conchoidal; blunt-edged.

Colour white, yellowish, or reddish white; brownish red, and several shades of yellow. Different colours are disposed in spots, veins, dots, stripes; or clouds; opaque; very soft; streak shining; adheres to the tongue; feels greasy.

Chem. Char.—Infusible before the blow-pipe; falls to pieces in water without forming a paste. According to some analyses, it contains a large proportion of magnesia.

Physical Char.—Some varieties when rubbed with a feather in the dark, give a little light.

Localities, &c.—Lithomarga or stone marrow, derives its name from its being found in nodules in amygdaloid rocks; it occupies veins or small fissures in porphyry, gneis, and serpentine. It is found in Bohemia, Saxony, France, England, and at the Giant's causeway in Ireland. A variety of lithomarga, which exhibits many fine colours, particularly violet or lavender blue, is found in beds reposing on coal at Planitz, near Zwickau in Saxony. It has been called, from its beautiful appearance, *wonder earth* of Saxony (Terra miraculosa).

27. Species. Mountain or Rock Soap.

Le Savon de Montagne, Brochant, i. 453.

Exter. Char.—This mineral is found massive; is dull internally; has an earthy, and sometimes an imperfectly conchoidal fracture; fragments blunt-edged.

Colour brownish black, spotted ochrey yellow. Opaque; very soft; easily frangible; streak shining, and resinous; stains and writes on paper; feels greasy, and adheres strongly to the tongue.

Localities, &c.—This mineral is rare; has been found at Olkutsch in Poland, and also, it is said, in England.

28. Species. Umber.

Exter. Char.—This mineral is found massive; fracture conchoidal; fragments blunt-edged.

Colour brownish, of various shades; soft; adheres a little to the tongue, and has a meagre feel.

Localities, &c.—Umber is found disposed in beds, in the island of Cyprus; and it is employed as a pigment.

29. Species. Yellow Earth.

Id. Kirw. i. 194. *La Terre Jaune*, Broch. i. 455.

Exter. Char.—Yellow earth is found massive; it is dull, or in the principal fracture, which is slaty, glimmering; cross fracture earthy; fragments very blunt-edged.

Colour ochrey yellow; very soft; streak shining; feels greasy, and adheres a little to the tongue.

Localities, &c.—It has only been found in small beds in stratified mountains, at Wehraw in Upper Lusatia,

Classification.

satia, and it is said, in the cavities of gray wacken, and in the fissures of a sandstone rock.

Uses.—It is employed in the arts as a pigment.

V. MAGNESIAN Genus.

1. Species. Native Magnesia.

Magnesie Native, Brochant, ii. 449.

Exter. Char.—Native magnesia is found massive, tuberous or carious. Surface uneven and dull. Fracture flat, conchoidal, splintery or earthy. Fragments sharp-edged.

Colour yellowish gray, with spots and dendritic delineations of black or blackish brown. Opaque, soft and easily frangible. Feels greasy; adheres to the tongue, and is rather light.

Constituent Parts.

Carbonic acid,	51.
Magnesia,	47·4
A trace of iron,	
Loss,	1.6
	100.0

Localities, &c.—This mineral was discovered by Dr Mitchell in a serpentine rock at Roubschitz in Moravia.

* *Jour. de Phys.* lx. 249.

A mineral in many respects similar to this has been analyzed by Giobert*. It was long known under the name of *porcelain earth*, and was successfully employed in that manufacture. Giobert supposes that the external characters, and particularly the colours, of the mineral found in Moravia, seem to indicate the existence of other substances beside those detected by Dr Mitchell's analysis.

Exter. Char.—The mineral described by Giobert is found massive or in mammillary fragments, some of which are tuberculated. Surface dull. Fracture conchoidal or uneven.

Colour pure white. Opaque. Spec. grav. variable. Hard, sometimes soft. Feels greasy; adheres slightly to the tongue. The softer varieties absorb water greedily and with a hissing noise.

Chem. Char.—Infusible before the blow-pipe.

Constituent Parts.

Magnesia,	68.
Carbonic acid,	12.
Silica,	15.6
Sulphate of lime,	1.6
Water,	3.
	100.2

Localities, &c.—This mineral is found at Baudissero, in a vein which traverses a steatitic rock of which the mountain is composed.

2. Species. Bole.

Id. Kirw. i. 190. *Le Bol*, Broch. i. 459. *Argile Ochreuse*, Hauy, 445.

Exter. Char.—Found massive and disseminated; surface dull, sometimes a little glimmering; fracture conchoidal; fragments sharp-edged.

Magnesian genus.

Colour yellowish brown or reddish, with spots and dendritical figures of black; opaque, rarely translucent at the edges; very soft; easily frangible; adheres to the tongue; feels greasy; streak shining: sp. grav. 1.4 to 2.

Chem. Char.—Before the blow-pipe it becomes black or gray, and melts into a greenish gray slag. Falls to pieces in water with a crackling noise, and without forming a paste.

Constituent Parts. Bergman.

Silica,	47.
Alumina,	19.
Magnesia,	6.2
Lime,	5.4
Oxide of iron,	5.4
Water,	17.
	100.0

Localities, &c.—The chief places which yield bole are the island of Lemnos, hence called *Lemnian earth*; Sienna in Italy, and Strigau in Silesia, in which latter place it is deposited on indurated clay; in Upper Lusatia it forms nests in basalt.

Uses.—Bole and similar earths were formerly employed in medicine; it is now only used in the preparation of colours.

Cimolite.

This is a mineral which in many of its characters is closely connected with the preceding.

Exter. Char.—It is found massive; fracture earthy uneven, or slaty; colour grayish white, pearl gray, and exposed for some time to the air, reddish; opaque; does not stain; adheres strongly to the tongue; is soft, and difficultly frangible: sp. grav. 2.

Chem. Char.—Before the blow-pipe it becomes at first of a deep gray colour, but afterwards white.

Constituent Parts. Klaproth.

Silica,	63.
Alumina,	23.
Oxide of iron,	1.25
Water,	12.
Loss,	·75
	100.00

Localities, &c.—This mineral was brought by Mr Hawkins from the island of Argentiers, formerly Cimolo, from whence it has its name. Olivier found a similar substance in the island of Milo, but which was very friable.

Uses.—This substance is employed in whitening woollen stuffs. It is described by Pliny under the name Cimolia, as being applied to the same purpose, and also as a medicine in his time.

It is to be observed that cimolite contains, according to the above analysis, no magnesia.

3. Species. Sea Froth.

Késſekill, Kirw. i. 144. *L'Ecume de Mer*, Broch. i. 462. *Argile glaise*, Hauy, iv. 433. *Meerschaum* of the Germans.

Exter.

Magnesian genus.

Exter. Char.—This mineral is found massive, disseminated, or in superficial layers. Surface dull. Fracture fine earthy, sometimes slaty. Fragments sharp edged.

Colour yellowish white. Opaque. Very soft. Easily frangible. Streak shining. Feels greasy; and adheres to the tongue. Sp. gr. 1.6.

Chem. Char.—Infusible before the blow-pipe.

Constituent Parts.	Klaproth.	
Silica,	50.5	41.
Magnesia,	17.25	18.25
Lime,	.5	.5
Water,	25.	39.
Carbonic acid,	5.	
Loss,	1.75	1.25
	100.00	100.00

Localities, &c.—Sea froth is found in Natolia, in the Crimea, in Spain and some other places. It appears to be distributed in low grounds in thin beds; and it is said to be in the state of soft paste which hardens in the air.

Uses.—It is employed in Turkey, in the manufacture of the heads of tobacco pipes; and as a detersive substance, like fullers earth, by the Tartars.

4. Species. Fullers Earth.

Id. Kirw. i. 184. *La Terre à Foulon*, Broch. i. 464. *Argile Smectique*, Hauy, iv. 443.

Exter. Char.—Found massive. Surface dull. Fracture fine grained earthy, conchoidal or slaty. Fragments blunt edged.

Colour olive green, yellowish or reddish. Colours sometimes mixed and disposed in spots or stripes; opake; soft or friable. Streak somewhat shining. Sometimes adheres to the tongue; feels greasy.

Chem. Char.—Does not effervesce with acids; melts into a brown spongy clay; falls to pieces in water without forming a paste, and does not froth up like soap.

Constituent Parts.	Bergman.
Silica,	51.8
Alumina,	25.
Lime,	3.3
Magnesia,	.7
Oxide of iron,	3.7
Water,	15.5
	100.00

Localities, &c.—Fullers earth is found in Sweden, Saxony, and France, forming beds; but the best fullers earth is found between strata of sandstone in Hampshire and some other places of England.

Uses.—Fullers earth is of great importance in woollen manufactures, on account of its detersive properties. It is extensively employed in the process of fulling or cleansing woollen stuffs from greasy matters.

5. Species. Steatites.

La Pierre de Lard, ou Steatite, Broch. i. 474. *Semi-indurated and Foliated Steatites*, Kirw. i. 151, and 154. *Tale Steatite*, Hauy, iii. 256.

Exter. Char.—Steatites is found massive, disseminated, and crystallized. Forms of the crystals, a six-sided prism terminated by a six-sided pyramid; a rectangular and rhomboidal four-sided prism; and a double six-sided pyramid. The crystals are small, generally imbedded in the massive variety; but they are very rare; and it is supposed, with some probability, that they are pseudo-crystals. Surface of the crystals smooth and shining. Internally dull; fracture coarse splintery, rarely earthy or slaty. Fragments blunt-edged.

Classification.

Colour greenish, yellowish, reddish or grayish. Colours sometimes mixed, and spotted or dendritical. Translucent at the edges. Soft, sometimes friable. Streak shining. Feels greasy. Sp. gr. 2.614.

Chem. Char.—Infusible before the blow-pipe; but becomes white and very hard.

Constituent Parts.	Klaproth.	
	From Cornwall.	From Bayreuth.
Silica,	48.	59.5
Magnesia,	20.5	30.5
Alumina,	14.	
Oxide of iron,	1.	2.5
Water,	15.5	5.5
Loss,	1.	2.
	100.0	100.0

Localities, &c.—Steatites is found in primitive mountains, forming beds and veins in serpentine rocks; sometimes in metallic veins, as in the tin mines near Freyberg. It is also imbedded in wacken, as in the island of Skye, and in veins of serpentine at Portsoy in Scotland. Steatites is also found in Cornwall in England, and in Sweden, Norway, Saxony, and France.

Uses.—Steatites is sometimes employed in the manufacture of porcelain, and some varieties of it answer for the same purpose as fullers earth.

6. Species. Figure Stone.

La Pierre à Sculpture, Broch. i. 451. *Le Bildstein* of the Germans.

Exter. Char.—This mineral is found massive. Internal lustre sometimes glimmering, sometimes dull, greasy. Fracture slaty; cross fracture splintery.

Colour olive green, greenish gray, yellowish brown, sometimes reddish, and veined. Semitransparent, or translucent at the edges, and sometimes opake. Soft; sectile; feels greasy. Sp. gr. 2.78 to 2.81.

Constituent Parts.	Klaproth.	
	Translucent.	Opaque Figure Stone.
Silica,	54.	62.
Alumina,	36.	24.
Lime,	—	1.
Oxide of iron,	.75	.5
Water,	5.5	10.
Loss,	3.75	2.5
	100.00	100.0

Localities, &c.—This mineral is brought from China, and is always cut into various, often singular, figures; and hence the name *bildstein*, or *sculpture stone*.

7. Species.

Classification.

7. Species. NEPHRITE, or *Jade*.

Jade, Kirw. i. 171. *Le Nephrite*, Broch. i. 467. *Jade*, Hauy, iv. 368.

This species is divided into two subspecies.

Subspecies 1. COMMON NEPHRITE.

Exter. Char.—This variety is found massive, disseminated, or in rounded pieces. The surface is smooth, glimmering, and unctuous; internally it is dull; fracture slaty or coarse splintery, rarely fibrous; fragments sharp-edged.

Colour leek green, sometimes inclining to blue, greenish or yellowish white; translucent, sometimes only at the edges; hard; very difficultly frangible; feels greasy. Sp. grav. 2.97 to 4.38.

Chem. Char.—Fusible before the blow-pipe, and melts into a semitransparent white glass.

Constituent Parts.	Hoepfner.
Silica,	47
Magnesia,	38
Alumina,	4
Lime,	2
Oxide of iron,	9
	100

Localities, &c.—The repository of nephrite is unknown. It was originally brought from the Levant, East Indies, and China. It is found also in the Alps, in Switzerland, and in Piedmont. The water-worn pebbles which are collected on the banks of the lake of Geneva often contain this mineral. It is found also in a similar form at a particular place on the shores of Iona, one of the Hebrides, in Scotland.

Uses.—Oriental nephrite, long known under the name of *Jade*, is held in considerable estimation on account of its hardness and tenacity. It is employed by the Turks for the handles of knives and sabres, and frequently by others for various ornamental purposes.

The property of curing diseases of the kidneys is ascribed to this mineral by ancient authors, and hence the name *nephritic stone*, or *nephrite*.

Subspecies 2. AXE STONE.

La Pierre de hache, Brochant, i. 470. *Beilstein* of the Germans.

Exter Char.—This is also found massive, but most frequently in rounded pieces; lustre glimmering, or weakly shining; fracture in large masses, slaty; in small, splintery; fragments in the form of plates.

Colour deep meadow-green, sometimes olive green; translucent; semihard, and sometimes hard; not very brittle; more difficultly frangible than the preceding variety.

Localities, &c.—This mineral is found in China, the East Indies, and South America, on the banks of the river Amazons. It is found also in some of the islands in the South Sea, as well as in Corsica, Switzerland and Saxony.

Uses.—Axe stone is employed as hatchets and other cutting instruments by the natives of those countries where iron is little known.

Magnesian genus.

8. Species. SERPENTINE.

Id. Kirw. i. 156. *La Serpentine*, Brochant, i. 481 *Roche Serpentineuse*, Hauy, iv. 436.

This species is divided into two subspecies.

Subspecies 1. COMMON SERPENTINE.

Exter. Char.—This mineral is found massive, very rarely disseminated; internal lustre slightly glimmering, or only dull; fracture splintery, or fine grained uneven, rarely conchoidal; fragments sharp-edged.

Colour blackish green, leek green, grayish, greenish, or bluish gray; in some varieties, red of various shades. These colours are mixed and disposed in spots, stripes, veins, and dots. Translucent at the edges, or opaque; semihard; not difficultly frangible; feels greasy. Spec. grav. 2.57 to 2.7.

Chem. Char.—Infusible before the blow-pipe.

Constituent Parts.	Kirwan.
Silica,	45
Alumina,	18
Magnesia,	22
Oxide of iron,	3
Water,	12
	100

Localities, &c.—Serpentine belongs to the class of primitive rocks, and it constitutes entire mountains. It is found in Saxony, Bohemia, Italy, Corsica, and Siberia; in Cornwall in England, where it contains native copper, and at Portsoy in the north of Scotland, where it is known by the name of *Portsoy marble*. Common serpentine is frequently mixed with steatites, talc, asbestus, garnets, and magnetic iron, but never contains limestone. This variety, in the language of Werner, is of a newer formation than the following subspecies.

Uses.—Serpentine is susceptible of a fine polish; on account of which, and its beautiful colours, it is employed for various ornamental purposes.

Subspecies 2. PRECIOUS SERPENTINE.

Exter. Char.—This also is found massive or disseminated; internal lustre glimmering, rarely weakly shining, resinous; fracture conchoidal, even or splintery; fragments sharp-edged.

Colour dark leek green of various shades; translucent; semi-hard; easily frangible; feels slightly greasy.

Localities, &c.—This subspecies is found in similar places with the preceding. It is distinguished from it by being always connected with limestone. The stones known in Italy by the name of *verde di Prato verde Antico*, *verde de Suza*, which are very often accompanied by limestone, may be included under precious serpentine.

9. Species. SCHILLER STONE.

Schillerspath, or *Spath Chatoyant*, Brochant, i. 421. *Schiller Spar*, Kirw. 221.

Magnesian genus.

Exter. Char.—This mineral is found disseminated in thin plates, which assume a crystallized form, as in that of a table with six sides, or a short six-sided prism; lustre shining, sometimes resplendent, and semi-metallic; fracture foliated.

Colour olive green, bronze yellow, or silvery white; soft; easily frangible; somewhat elastic; feels greasy.

Chem. Char.—Before the blow-pipe it melts with borax, into a glass which becomes opaque on cooling.

Constituent Parts.	Heyer.
Silica,	52
Alumina,	23.33
Magnesia,	6
Lime,	7
Oxide of iron,	11.67
	100.00

Localities, &c.—Schiller stone is found at Basta in the Hartz, in Moravia, the Tyrol, in Corsica, and in Cornwall. It is usually imbedded in serpentine, and is accompanied by quartz, mica, and copper pyrites. It is supposed by some to be crystallized serpentine.

10. Species. Talc.

This species is divided into three subspecies; 1. earthy, 2. common, and 3. indurated talc.

Subspecies 1. Earthy Talc.

Talcite, Kirw. i. 149. *Le Talc Terreux*, Broch. i. 486. *Tale Granuleur*, Hauy, iii. 255.

Exter. Char.—Earthy talc is found disseminated in kidney-form masses, or in superficial layers; lustre glimmering, pearly; friable; the particles scaly, pulverulent, or slightly cohering.

Colour greenish, reddish, or silvery white; stains; feels greasy, and is light.

Localities, &c.—This mineral is found in Piedmont, Saxony, Bohemia, and in the western parts of Invernessshire in Scotland, where it exists in veins or cavities of primitive rocks.

Subspecies 2. Common Talc.

Id. or *Venetian Talc*, Kirw. i. 150. *Le Talc Commun*, Broch. i. 487. *Talc Laminaire*, Hauy, iii. 255.

Exter. Char.—This mineral is found massive, disseminated, and rarely crystallized in very small six-sided tables; lustre shining or resplendent, pearly or metallic; fracture straight or curved foliated; fragments wedge-shaped.

Colour greenish white, pale apple green, reddish or yellowish white; translucent or semitransparent, in thin plates transparent, soft, flexible, but not elastic; feels greasy. Spec. grav. 2.7 to 2.8.

Chem. Char.—Infusible before the blow-pipe, which distinguishes it from chlorite; does not effervesce with acids.

Constituent Parts.	Hoepfner.
Silica,	50
Magnesia,	44
Alumina,	6
	100

Classification.

Localities, &c.—Common talc is always found in serpentine rocks, where it accompanies actynolite, steatites, and indurated talc. What is called Venetian talc is brought from the mountains of Saltzburg and the Tyrol.

Uses.—Talc is sometimes employed as a substitute for chalk, enters into the composition of crayons, and is mixed with some kinds of paint.

Subspecies 3. Indurated Talc.

Le Tale Endurci, Broch. i. 489.

Exter. Char.—This is found massive, and sometimes, it is said, crystallized; lustre shining and resplendent, resinous or pearly; fracture curved foliated, or slaty; fragments blunt-edged, tabular.

Colour greenish white, snow white, or apple green; translucent; in thin plates semitransparent; very soft; smooth, and greasy to the feel.

Localities, &c.—Indurated talc forms beds in mountains of argillaceous schistus, gneis, and serpentine, in the Tyrol, Italy, and Switzerland, and also in the western parts of Scotland.

Uses.—It is applied to the same purposes as the preceding.

11. Species. Asbestus.

This is divided into four subspecies: 1. mountain cork; 2. amianthus; 3. common asbestus; and, 4. ligniform asbestus.

Subspecies 1. Mountain Cork.

Suber Montanum, Kirw. i. 163. *Le Liege de Montagne*, Broch. i. 492. *Asbeste Tressé*, Hauy, iii. 247.

Exter. Char.—This mineral is found massive, often in small plates, which are sometimes thin, and are then denominated *mineral paper;* sometimes thick, and then called *mineral leather;* more rarely in porous or cellular pieces, when they are denominated *mineral flesh;* sometimes it is marked with impressions; the lustre is weakly glimmering or dull; fracture to appearance compact and uneven, but it is fibrous, and the fibres are sometimes parallel, and sometimes interwoven; fragments very blunt-edged.

Colour yellowish or grayish white; opaque; very soft, extremely difficult to break; in thin plates flexible and elastic; creaks when handled; feels meagre. Spec. grav. 0.68 to 0.993.

Chem. Char.—Melts before the blow-pipe with difficulty.

Constituent Parts.	Bergman.
Silica,	56.2
Magnesia,	26.1
Alumina,	2
Lime,	12.7
Oxide of iron,	3
	100.0

Localities, &c.—This mineral is found in thin veins in serpentine rocks: it is often mixed with quartz, talc, and silver ores, as in Saxony. It is also found in Sweden, Norway, Siberia, Hungary, and in the lead veins at Leadhills in Scotland.

Subspecies

Classification.

Subspecies 2. Amianthus.

Id. Kirw. i. 161. *L'Amianthe*, Broch. i. 494. *Asbeste Flexible*, Hauy, iii. 247.

Exter. Char.—This variety is also found massive, more rarely disseminated, and in small detached bundles; lustre glimmering, or a little shining and silky; fracture fibrous straight or parallel.

Colour greenish or silvery white, yellowish white, or greenish gray; opaque; rarely translucent at the edges; very flexible, and even elastic in thin fibres; feels greasy.

Chem. Char.—Melts with difficulty before the blow-pipe, into a white, gray, yellow, and sometimes black enamel.

Constituent Parts.	Bergman.	Chenevix.	
Silica,	64	64	59.
Magnesia,	17.2	18.6	25.
Alumina,	2.7	3.3	3.
Lime,	13.9	6.9	9.25
Barytes,		6.	
Oxide of iron,	2.2	1.2	2.25
Loss,			1.50
	100.0	100.0	100.00

Localities, &c.—Amianthus is usually found in primitive rocks, but particularly those of serpentine. It is found in Saxony, Bohemia, Italy, Spain, France, Sweden, and in the western parts of Scotland; but the finest specimens of amianthus are brought from the island of Corsica.

Uses.—On account of the flexibility of this substance it is spun into threads; for this purpose it is mixed with lint, to render the threads less brittle in working them into cloth, which is afterwards passed through the fire that the vegetable matter may be consumed, and the amianthus, which is infusible, remains; and thus an incombustible cloth is obtained. The ancients manufactured this cloth for the purpose of wrapping round their dead bodies, that their ashes might be preserved unmixed with the wood employed in burning them.

Subspecies 3. Common Asbestus.

Asbestus, Kirw. i. 159. *L'Asbeste Commune*, Brochant, i. 497. *Asbeste Dur*, Hauy, iii. 247.

Exter. Char.—This also is found massive; lustre shining and weakly shining, silky or resinous; surface fibrous, the fibres being parallel, straight, or curved; the fibres are more strongly united than in amianthus, and hence sometimes a splintery fracture.

Colour leek green, greenish, or yellowish gray; translucent at the edges; soft, or semihard; rather easily frangible; little flexible; feels greasy; spec. grav. 2.54 to 2.99.

Chem. Char.—Melts with difficulty before the blow-pipe, into a dark gray slag.

Constituent Parts.	Wiegleb.
Silica,	46.66
Magnesia,	48.45
Oxide of iron,	4.79
Loss,	.1
	100.00

Localities.—It is found in similar situations with the preceding, in Saxony, Russia, Sweden, and in the western parts of Scotland. Magnesian genus.

Subspecies 4. Ligniform Asbestus.

Id. Kirw. i. 161. *Le Bois de Montagne*, Brochant i. 499. *Asbeste Ligniforme*, Hauy, iii. 248.

Exter. Char.—This also is found massive; lustre glimmering, silky; fracture in large masses, curved slaty; in small pieces fibrous, and having the appearance of a woody texture; fragments in elongated plates.

Colour yellowish brown of different shades; opaque; soft; not difficultly frangible; in thin fragments a little flexible, but not elastic; feels meagre; adheres to the tongue; streak shining.

Chem. Char.—Before the blow-pipe is only fusible at the edges.

Localities, &c.—This variety is found in the Tyrol, where it is accompanied by galena, black blende, and a grayish white quartz.

12. Species. Cyanite.

Id. Kirw. i. 209. *La Cyanite*, Broch. i. 501. *Sappare*, *Sauss.* § 1900. *Disthene*, Hauy, iii. 220.

Exter. Char.—This mineral is found massive, disseminated, or crystallized, in four-sided prisms, of which two are broad and two narrow, and having the four lateral edges, or only the two opposite edges, truncated. This prism is often so flattened, as to have the appearance of a table. The broad faces of the crystals are smooth and shining, the narrow faces streaked and only glimmering, almost dull. Internal lustre shining and pearly; fracture curved radiated; that of the crystals foliated; fragments tabular, sometimes splintery, or imperfectly rhomboidal.

Colour blue of various shades, sometimes bluish and pearl gray; and different colours are arranged in stripes, spots, or clouds; translucent, or when crystallized semitransparent, or transparent; semihard, and sometimes soft; easily frangible; feels greasy. Spec. grav. 3.51 to 3.62.

Chem. Char.—Entirely infusible before the blow-pipe, on which account this mineral was employed by Saussure as a support for other substances in experiments with that instrument.

Constituent Parts.	Saussure.
Silica,	29.2
Alumina,	55.
Lime,	2.25
Magnesia,	2.
Oxide of iron,	6.65
Water and loss,	4.9
	100.00

Localities, &c.—Cyanite is found on St Gothard in Switzerland, in crystals mixed with quartz, garnets, and granite, and imbedded in indurated talc. It is also found in Spain, France, Carinthia, Bavaria, Siberia, and in the north of Scotland, and always in primitive mountains.

Magnesia genus.

13. Species. Actynolite.

This is divided into three species; 1. asbestous, 2. common, and 3. glassy.

Subspecies 1. Asbestous Actynolite.

Amianthinite, Kirw. i. 164. and *Metalliform Asbestoid*, ibid. 167. *La Rayonnante Asbestiforme*, Broch. i. 504. *Actinote Aciculaire*, Hauy, iii. 75.

Exter. Char.—This mineral is found massive, and rarely crystallized in rhomboidal six-sided prisms, two of which are about 124° 30′, and four about 117° 45′; lustre glimmering; internal lustre weakly shining, sometimes shining, pearly; fracture radiated; fragments wedge-shaped.

Colour white, or greenish, reddish, or yellowish gray; commonly opaque; sometimes translucent at the edges; streak greenish white; soft, rarely semi-hard; rather difficultly frangible. Specific gravity 2.58 to 3.33.

Chem Char.—Fusible before the blow-pipe into a black slag, or grayish white enamel.

Localities, &c.—Found in the neighbourhood of Bayreuth and the Bannat, in beds of serpentine and steatites.

Subspecies 2. Common Actynolite.

Asbestinite, Common, Asbestoid, and *Schorlaceous Actynolite*, Kirw. i. 165—168. *La Rayonnante Commune*, Broch. i. 507. *Actinote Hexaëdre*, Hauy. iii. 74.

Exter. Char.—Massive, disseminated, crystallized in elongated, very oblique, six-sided prisms, having the acute lateral edges truncated. The crystals are aeicular, and longitudinally streaked; lustre shining and vitreous; fracture radiated, parallel or divergent, stellated; fragments rather blunt-edged.

Colour olive green, pistachio green, reddish brown; crystals translucent or semitransparent; semihard; difficultly frangible; rarely feels greasy. Spec. grav. 3. to 3.31.

Chem. Char.—Fusible before the blow-pipe into a black slag, a white transparent glass, or a grayish white enamel.

Constituent Parts.	Bergman.
Silica,	64
Magnesia,	20
Alumina,	2.7
Lime,	9.3
Oxide of iron,	4
	100.0

Localities, &c.—It is found in Saxony, Switzerland, Norway, and west side of Inverness-shire in Scotland. Its repository is in primitive mountains, where it is accompanied with ores of lead and iron, as well as with quartz and brown blende.

Subspecies 3. Glassy Actynolite.

Id. Kirw. i. 168. *La Rayonnante Vitreuse*, Broch. i. 510. *Thallite*, Lametherie, ii. 319. *Epidote*, Hauy, iii. 102.

Classification.

Exter. Char.—Found massive or crystallized in thin six-sided prisms, whose surface is smooth and resplendent; internal lustre shining, vitreous; fracture radiated or wedge-shaped, fibrous; fragments splintery.

Colour olive green, leek green, and asparagus green; translucent, or semitransparent; semihard, or hard; very brittle, and very easily frangible. Spec. grav. 2.95 to 3.49.

Localities, &c.—This variety is found in similar repositories, and in similar places with the preceding.

14. Species. Tremolite.

This is also divided into three subspecies; 1. asbestous, 2. common, and 3. glassy.

Subspecies 1. Asbestous Tremolite.

La Tremolithe Asbestiforme, Broch. i. 514. *Grammatite*. Hauy, 227.

Exter. Char.—Found massive, disseminated, and crystallized; and the crystals are capillary or acicular; lustre weakly shining, silky or pearly; fracture radiated or fibrous; fragments splintery and wedge-shaped.

Colour yellowish white, reddish, greenish, or grayish; opaque; translucent at the edges; very soft; easily frangible.

Subspecies 2. Common Tremolite.

La Tremolithe Commune, Broch. i. 515.

Exter. Char.—Massive, or crystallized in rhomboidal prisms, with angles of 126° 52′ 12″, and 53° 7′ 48″. The crystals are deeply striated longitudinally; external lustre resplendent; internal shining, pearly; fracture radiated, either parallel, divergent, or promiscuous; surfaces of the fracture longitudinally streaked; fragments splintery.

Colour greenish white, reddish, or yellowish; rarely pearl gray; always translucent; in crystals semitransparent; semihard; brittle; easily frangible; meagre to the feel.

Subspecies 3. Glassy Tremolite.

La Tremolithe Vitreuse, Broch. i. 516.

Exter. Char.—Massive, or crystallized in long needle or awl-shaped prisms; internal lustre shining, and sometimes resplendent; vitreous or pearly; fracture radiated; cross fracture even, and a little oblique; fragments splintery.

Colour greenish or yellowish white; translucent; crystals sometimes transparent; semihard; brittle; easily frangible; feels meagre. Spec. grav. 2.90 to 3.2, Hauy.

Chem. Char.—Before the blow-pipe it melts into a porous white slag.

Constituent

Classification.

Constituent Parts.

	Klaproth.	Laugier.	
		White.	Gray Tremolite.
Silica,	65.	35.5	50
Lime,	18.	26.5	18
Magnesia,	10.33	16.5	25
Oxide of iron,	.16		
Carbonic acid and water,	6.5	23.	5
Loss,	.01	—	2
	100.00	101.5	100

Physical Char.—By percussion or friction in the dark, a reddish phosphorescent light appears; and the powder thrown on burning coals yields a greenish light.

Localities, &c.—Tremolite is found imbedded in limestone, in primitive mountains. It was first discovered in the valley of Tremola by Pini, and hence its name. It is also found in Hungary, Bohemia, and Carinthia, and in the mountains six miles south of Paisley in Scotland, where it is accompanied with prehnite.

15. Species. SMARAGDITE.

Id. Saussure Voy. § 1313. *Diallage*, Hauy, iii. 125. *Id.* Brochant, i. 423. and ii. 506.

Exter. Char.—Smaragdite has been found massive and disseminated. Internal lustre shining. Fracture foliated. Cleavage single. Fragments rather sharp edged.

Colour, grass or emerald green. Slightly translucent. Semi-hard or soft. Brittle. Spec. grav. 3.

Chem. Char.—Before the blow-pipe melts into a gray or greenish enamel.

Constituent Parts.	Vauquelin.
Silica,	50.
Alumina,	11.
Lime,	13.
Magnesia,	6.
Oxide of iron,	5.5
——— chromium,	7.5
——— copper,	1.5
Loss,	5.5
	100.0

Localities, &c.—This mineral was found by Saussure in the vicinity of Turin, imbedded in nephrite clouded white and blue. It has also been found near the lake of Geneva among the rounded pebbles, and in Corsica in primitive rocks. In Italy, tables and ornamental pieces of furniture are made of smaragdite; and the Italian marble-cutters call it *verde di Corsica.*

16. Species. SAHLITE.

Id. D'Andrada, Jour. de Phys. An. 8. p. 241. *Malacolithe*, Hauy, iv. 379. *Id.* Brochant, ii. 518.

Exter. Char.—Found massive or crystallized in six-sided prisms, having two opposite lateral edges truncated. Lustre slightly glimmering, resinous. Fracture foliated. Cleavage threefold. Fragments sometimes rhomboidal. Calcareous genus.

Colour grayish green or bluish gray. In thin plates translucent. Scarcely scratches glass. Very soft to the touch, from which it has the name *malacolite*. Spec. grav. 3.2307 to 3.2368.

Chem. Char.—Fusible before the blow-pipe into a porous glass.

Constituent Parts.	Vauquelin.
Silica,	53
Lime,	20
Magnesia,	19
Alumina,	3
Iron and manganese,	4
Loss,	1
	100

Localities, &c.—This mineral was discovered by D'Andrada in the silver mines of Sahla in Sweden, and hence it derived its name. It was found by the same naturalist at Busen in Norway. It appears from the observations of Hauy that sahlite and augite are very closely allied, not only in structure and external characters in general, but also in their constituent principles; the only difference in their composition is in the proportions of the lime and magnesia, which are smaller in augite than in sahlite; but the proportion of iron in the former is considerably greater than in the latter.

17. Species. SCHALSTONE, or TABULAR SPAR.

Exter. Char.—This mineral is found massive; lustre shining and pearly; fracture foliated or splintery, and coarse fibrous; consists of separate large-grained pieces implicated in each other; and according to Karsten, are very regular.

Colour milk white, yellowish or reddish white; translucent; semi-hard; brittle.

Constituent Parts.	
Silica,	50
Lime,	45
Water,	5
	100

Localities, &c.—This mineral was first noticed by Stutz. It is found in the bannat of Temeswar, and is accompanied by crystallized garnets and calcareous spar.

VI. CALCAREOUS GENUS.

1. Species. AGARIC MINERAL, or *Mountain Milk.*

Id. Kirwan, i. 76. *Id.* Brochant, i. 519. *Chaux Carbonaté Spongieuse*, Hauy, ii. 167.

Exter. Char.—This mineral is composed of fine pulverulent particles, slightly united together, and nearly friable.

Colour yellowish white, or snow white; stains strongly;

Calcareous genus.

ly; feels meagre; does not adhere to the tongue; nearly floats on water.

Chem. Char.—Effervesces with acids, and is entirely dissolved, so that it is chiefly composed of lime and carbonic acid.

Localities, &c.—This mineral is found in the fissures and cavities of calcareous mountains, and it is supposed that it originates from the destruction of the rocks, the particles of which are carried down to the fissures and cavities by rain water. Abundant in Switzerland.

2. Species. Chalk.

Id. Kirwan, i. 71. *La Craie*, Brochant, i. 521. *Chaux Carbonaté Crayeuse*, Hauy, ii. 166.

Exter. Char.—Found massive; has a dull appearance; fracture earthy, and fragments blunt-edged.

Colour usually snow or yellowish white, sometimes gray or brown; opaque; stains and writes; very soft, and easily frangible; feels meagre; adheres a little to the tongue. Spec. grav. 2.31 to 2.65.

Chem. Char.—Effervesces with acids; before the blow-pipe is calcined, and converted to quicklime. It is almost entirely composed of lime and carbonic acid, with a mixture of a little oxide of iron and some other substances.

Localities, &c.—Chalk forms peculiar stratiform mountains which contain many petrifactions, the matter of which is almost always siliceous. They contain also flints arranged in regular strata. No metallic substances are found in chalk. A great body of chalk traverses France from south to north, extending from Champagny to Calais, and continued to England, in the south of which it forms extensive beds. Chalk is also found in the island of Zealand, in the Baltic, in Poland and many other places.

3. Species. Limestone.

This is divided into four subspecies, which are, 1. compact, 2. foliated, 3. fibrous, and 4. pea stone.

Subspecies 1. Compact Limestone.

This subspecies is again divided into two sections; the first including common compact limestone, and the second roe-stone.

A. *Common Compact Limestone.*

Id. Kirw. i. 82. *Id.* Broch. i. 523. *Chaux Carbonaté Compacte*, &c. Hauy, ii. 164.

Exter. Char.—Found massive; external form frequently figured from the numerous petrifactions which it contains; internally dull; rarely glimmering; fracture compact, splintery, uneven or earthy; fragments not very sharp-edged.

Colour usually gray, sometimes reddish or yellowish; different colours exhibit spots, stripes, veins, and dendritical figures; translucent at the edges; semihard; brittle; easily frangible; feels meagre; gives a grayish white streak. Spec. grav. 2.6 to 2.7.

Chem. Char.—Dissolves in acids with effervescence.

The constituents of limestone are carbonate of lime, with variable proportions of other earths, and particularly alumina and silica. The following are the constituent parts of magnesian limestone examined by Mr Tennant.

Classification.

Lime,	29.5
Magnesia,	20.3
Carbonic acid,	47.2
Alumina and oxide of iron,	.8
Loss,	2.2
	100.0

Localities, &c.—Forms very extensive stratiform mountains, and is usually met with along with coal and sandstone. It is very abundant in Saxony, Bohemia, Sweden, France, Switzerland, and Britain. The magnesian limestone is abundant in Yorkshire and Nottinghamshire.

Uses.—The uses of limestone for the purposes of building, and when reduced to the state of quicklime, to form the basis of mortar, as well as in various arts, are well known.

This variety of limestone, when susceptible of a polish, furnishes *marbles;* which name, although it be applied to very different stones which are susceptible of a polish, and are fit for sculpture, or ornamental architecture, is frequently applied to limestone of this description.

B. *Oolite*, or *Roe Stone.*

Id. Brochant, i. 529. *Oviform Limestone*, Kirw. i. 91. *Chaux Carbonaté Globuliforme*, Hauy, ii. 171.

Exter. Char.—This is found massive; internally dull; fracture compact; fragments blunt-edged.

Colour yellowish, smoke gray, hair, or reddish brown; opaque; rarely translucent at the edges; semihard; consists of small globular, distinct concretions: the size of the concretions are very various. Spec. grav. 2.4 to 2.5.

Localities, &c.—Roe stone is found in Sweden, Switzerland, Saxony, and in the south of England.

The ketton stone of England, and the celebrated Portland stone, belong to this variety. Of the latter some of the principal public buildings in England and Ireland are constructed.

Uses.—It is employed as a building stone; and when of a fine grain, it is polished and employed as marble.

Subspecies 2. Foliated Limestone.

Of this there are two varieties, granularly foliated, and calcareous spar.

A. *Granularly Foliated Limestone.*

Pierre Calcaire Grenue, Broch. i. 531. *Chaux Carbonaté Saccharoïde*, Hauy, ii. 164.

Exter. Char.—Found only massive; lustre shining, or strongly glimmering; between pearly and vitreous; fracture straight foliated; fragments rather blunt-edged; in granular, distinct concretions, small or fine grained.

Colour usually snow white, grayish, yellowish, greenish, and rarely reddish white, and sometimes it is spotted, veined, or striped; usually translucent; semihard; feels meagre; brittle, and easily frangible. Spec. grav. 2.7 to 2.8.

Chem.

Classification.

Chem. Char.—Effervesces with acids, and is almost entirely dissolved. Some varieties, however, from an admixture of other substances, are very slowly acted on by acids.

Localities, &c.—Granularly foliated limestone belongs almost exclusively to the primitive and transition mountains, reposing on gneis, micaceous schistus, and clay slate, containing, beside other mineral substances, various metallic ores.

It is found in Italy, Saxony, Bohemia, Sweden, Norway, France, and Britain.

Uses.—This variety of limestone is applied to the same purposes as the former.

Of MARBLES.—In the language of the architect and statuary, all stones come under the name of marble which are harder than gypsum, are found in large masses, and are susceptible of a good polish.

On this principle many varieties of limestone, granite also and porphyry, serpentine, and even fine-grained basalts, are denominated marbles. But the word among mineralogists is taken in a more restricted sense, and confined to such varieties of dolomite, swinstone, and compact and granularly foliated limestone, as are capable of receiving a good polish. The most valuable of the calcareous marbles, for hardness, durability and colour, are brought from Italy, the Greek islands, and from Syria. When the ancient Romans were at the height of their civilized luxury, they obtained some varieties of marble from Numidia and other countries, which were very much esteemed.

The sculptors of ancient Greece and modern Europe have always held the white granularly foliated limestone in the highest estimation, both on account of its pure colour, delicate translucence, and granular texture, which make it much easier to work than compact limestone. The species called dolomite is softer and of a finer grain, so that it is even more manageable under the chissel, and therefore many of the smaller works of the Greek sculptors are of this stone; but Paros and Carrara furnish Europe with the greatest quantity of statuary marble. The Parian marble, which consists almost entirely of carbonate of lime, is the purest, softest, and has some degree of transparency; that of Carrara is often mixed with granular quartz in considerable proportion. The following are the architectural marbles which are held in greatest estimation.

1. The marble called *bardiglio*, from Carrara, is of a deep blue colour, and seems to be the same with the white statuary marble of that place, with the addition of some colouring matter.

2. That variety of marble called *cipolin*, is statuary marble traversed by veins of mica.

3. *Lumachella marble.* This is a compact limestone of a brownish gray colour, containing shells which often retain the original pearly lustre. To this variety belongs the fire marble of Bleyberg in Carinthia, in which the imbedded shells are beautifully iridescent.

4. *Florentine marble.* This is a grayish, compact, argillaceous limestone, exhibiting designs of a yellowish brown colour, and resembling the ruins of houses: hence it is called *ruin marble.*

5. The marbles of Syria, Sienna, and Arragon, are of a yellow colour, and are in considerable estimation.

6. *Brocatello marble.* This is a breccia limestone, composed of fragments of a yellowish red and purple colour which are cemented by semitransparent, white calcareous spar.

Calcareous genus.

7. The marbles known by the names of *verde antiche*, *verde di Corsica*, are composed of limestone, calcareous spar, serpentine, and asbestus.

8. The British islands afford many fine marbles, of which that of Tiree is the finest and most beautiful. It has often a delicate flesh-coloured ground, spotted with green; but its colours, it is said, are apt to fade. Marbles have also been found in the island of Skye, and in the counties of Ross and Sutherland. For a particular account of these, see *Williams's Mineral Kingdom.* Marble is not uncommon in different parts of England; and in particular Devonshire and Derbyshire afford varieties which are held in considerable estimation on account of their beauty.

Elastic marble. Some varieties of granular limestone, when cut into thin plates, possess a certain degree of elasticity. The marble in which this property was observed, was in the Borghese palace at Rome. It was got from an ancient building. Dolomieu supposed that marble acquired this property by being deprived of moisture, and Fleuriau de Bellevue confirmed this opinion, by subjecting certain marbles to heat. He found also a natural elastic marble in Mount St Gothard.

B. *Calcareous Spar.*

Common Spar, Kirw. i. 86. *Le Spath Calcaire*, Broch. i. 536. *Chaux Carbonatée*, Hauy, ii. 127.

Essen. Char.—Divisible into a rhomboid of $101\frac{1}{2}^{\circ}$ and $78\frac{1}{2}^{\circ}$: soluble with effervescence in nitric acid.

Exter. Char.—Calcareous spar is found massive, or disseminated in various forms, as globular, kidneyform, cellular, and stalactitical; but it is most frequently crystallized. The primitive form of its crystals is an obtuse rhomboid, whose angles are 101° 32′ 13,′ and 78° 27′ 47″; integrant molecule the same. The variety of forms of calcareous spar is very great. Werner reduces them to three principal or prevailing forms, and from these he deduces the variations and modifications which take place. His principal forms are, 1. The six-sided pyramid; 2. The six-sided prism; and, 3. The three-sided pyramid. But according to others following the same method, the principal forms are the five following: 1. The six-sided pyramid; 2. The six-sided prism; 3. The six-sided table; 4. The three-sided pyramid; and, 5. The hexahedron, including the rhomboid and cube.

1. The six-sided pyramid is either simple or double.

A. Simple. Simple pyramids are the summits of other pyramids, or of prisms, and they are variously modified in being equal sided, acute, or obtuse, having the angles at the base truncated, or having an obtuse three-sided summit slightly convex.

B. Double; in which two pyramids are obliquely united, and variously modified, by having the angles at the base truncated, or the faces of the summit a little convex.

2. The six-sided prism, is also variously modified, by having at each extremity a six-sided acute summit, or a second obtuse summit of three sides, placed alternately on three edges of the first.

3. A six-sided table, which is either perfect with equal or unequal sides, or rounded, or lenticular.

Calcareous genus.

4. The three-sided pyramid, which is either simple or double, and is also variously modified.

5. The hexahedron, which includes the rhomboid, and this is either perfect, or has convex faces, or has six obtuse edges truncated; and the cube, which is somewhat rhomboidal. But for a full account of all the varieties and modifications in the crystallization of calcareous spar, the reader is referred to the treatises of Hauy and Brochant.

The crystals of calcareous spar exhibit also a similarity of arrangement. The simple six-sided pyramids are frequently disposed in a globular, fascicular, or stellated form. The six-sided pyramids are disposed in rows; the six-sided prisms are often disposed like steps of stairs, or are fascicular, or kidney-form; some acute three-sided pyramids of calcareous spar have been found hollow, and in some prisms the centre has been observed of another colour. The surface of the crystals commonly smooth; lustre shining or resplendent; internal lustre resplendent or shining, vitreous, and sometimes pearly; fracture foliated; cleavage threefold; fragments always rhomboidal.

Colour usually white, grayish, reddish, greenish, or yellowish, white, rarely violet blue, or yellowish brown. Various degrees of transparency; when perfectly transparent, refraction is double. It was in this substance that the property of double refraction was first observed, and hence it was called *double spar*. This singular property engaged the attention and mathematical skill of Newton, Huygens, Buffon, and more lately the celebrated Hauy. Calcareous spar is semihard, brittle, and easily frangible. Sp. grav. about 2.7.

Chem. Char.—Soluble with effervescence in nitric acid, and reduced by calcination to quicklime.

Constituent Parts.

	Bergman.	Phillips*.
Lime,	55	55·5
Carbonic acid,	33	44·
Water,	11	·5
	100	100.0

* *Phil. Mag.* xiv. 290.

Physical Char.—Some varieties of calcareous spar, and particularly those from Derbyshire, give out, when heated, a phosphorescent light.

Localities, &c.—Calcareous spar is very common in all kinds of rocks, in veins and cavities, and particularly in mineral veins, accompanied with quartz, fluor spar, heavy spar, and metallic ore. The finest specimens of rhomboidal spar are brought from Iceland, Derbyshire, the Hartz, as well as Saxony, France, and Spain.

The crystallized sandstones of Fontainebleau are real rhomboidal crystals of calcareous spar, which, during the process of crystallization, have been penetrated with particles of sand.

Subspecies 3. Fibrous Limestone.

Id. Kirw. i. 88. *La Pierre Calcaire Fibreuse, ou la Stalactite Calcaire*, Broch. i. 549. *Chaux Carbonatée Concretionnée*, Hauy, ii. 168.

Of this subspecies two varieties have been formed, common fibrous, and calcareous sinter.

A. *Common Fibrous Limestone.*

Classification.

Exter. Char.—Found massive; lustre weakly shining and pearly; fracture fibrous, sometimes coarse and delicate, straight or parallel, and sometimes radiated; fragments splintery.

Colour usually grayish, reddish, and yellowish white; generally translucent; rarely semitransparent.

Localities, &c.—This variety is found in veins; and some of it is susceptible of a fine polish, and was known to the ancients under the name of *calcareous alabaster*, to distinguish it from gypseous alabaster.

Sattin spar, a beautiful mineral, which is also susceptible of a fine polish, and has a sickly lustre, from which it derives its name, belongs to this variety. It was first discovered in Cumberland, and is but rarely met with in other places.

B. *Calcareous Sinter.*

This variety is usually found stalactitical or tuberose, and also sometimes kidney-shaped, botryoidal, tubular, and coralloidal. Surface usually rough, or drusy, rarely smooth; internal lustre glimmering, sometimes weakly shining, silky, or pearly; fracture fibrous, which is either straight, scopiform, or stellular; fragments wedge-shaped and splintery.

Colour snow white, grayish green, or yellowish white, and these are sometimes arranged in stripes or veins; translucent, sometimes only at the edges; rarely semitransparent; between semihard and soft; brittle and easily frangible. Sp. grav. 2.728.

Localities, &c.—This mineral seems to be a deposition of calcareous particles, formed by the gradual infiltration of water into the cavities and fissures of limestone mountains. They are either deposited in layers on the floor, or suspended from the roof of those grottoes, and in this latter case they assume a great variety of imitative forms. It is found therefore in the celebrated grottoes of Auxelles, Arcy, and Antiparos, and in the cavities of mineral veins at Leadhills.

The singular mineral substance, known by the name of *flos ferri*, belongs to this variety. This is found in the cavities of veins of spathose iron ore, from which it has derived its name. It is of a branched or coralloidal form.

Subspecies 4. Pisolite or *Pea-stone.*

Oviform Limestone, var. Kirw. i. 91. *La Pierre de Pois*, Broch. i. 555. *Chaux Carbonatée Globuliforme*, Hauy, ii. 171.

Exter. Char.—This mineral is found massive, and in the cavities in which it is formed, the surface is kidney-shaped; internally dull; fracture difficult to determine, but appears even; fragments rather sharp-edged.

Colour white, snow white, grayish, reddish or yellowish white; opaque; rarely translucent at the edges; soft, and brittle.

Localities, &c.—Pisolite is found at Carlsbad in Bohemia, where it has been long known, and where an entire bed was discovered in digging the foundations for a church. Each of the grains of pisolite contains for a nucleus a particle of sand. These have been incrusted with the carbonate of lime held in solution by water,

Classification.

water, and particularly by the warm springs of Carlsbad. New concentric layers being deposited, they at last fall to the bottom, and are there united into larger masses by new depositions of the same calcareous matter. Pisolites are also found in Hungary and in Silesia.

4. Species. Calcareous Tufa.

Exter. Char.—This mineral has usually the form of the substance on which the calcareous matter has been deposited, as that of moss which is most common, grass or leaves; internally dull, or weakly glimmering; fracture uneven or earthy; fragments blunt-edged.

Colour yellowish gray of various shades; opaque, or translucent at the edges; soft, sectile, and easily frangible; light; almost swims on water.

Localities, &c.—This substance is found in all limestone countries, through the strata of which water passes, thus forming springs impregnated with carbonate of lime, which is afterwards deposited on plants or other substances. This mineral, therefore, is found in alluvial land, and the process of its formation is constantly going on.

5. Species. Foam Earth.

Silvery Chalk, Kirw. i. 78. *L'Ecume de Terre*, Broch. i. 557.

Exter. Char.—This mineral is found massive, disseminated, or in scaly particles, which are somewhat friable; internal lustre shining or semimetallic; the solid varieties have a curved foliated fracture; fragments blunt-edged.

Colour yellowish or greenish white, sometimes silvery white; opaque; stains; very soft or friable; feels a little greasy or silky.

Chem. Char.—Effervesces and dissolves in acids.

Constituent Parts.

Lime,	51.5
Carbonic acid	39.
Silica,	5.7
Oxide of iron,	3.2
Water,	1.
	100.5

Localities, &c.—This mineral has been found in mountains of stratified limestone at Jena in Misnia, and at Eisleben in Thuringia.

This is considered by some as belonging to the following species, and by others as merely a variety of agaric mineral.

6. Species. Slaty Spar.

Argentine, Kirw. i. 105. *Le Spathe Schisteux*, Broch. i. 558. *Schiefer Spath of the Germans. Id.* Phillips, Phil. Mag. xiv. 289. and 293.

Exter. Char.—Found massive or disseminated; internal lustre shining, pearly; fracture curved foliated; fragments wedge-shaped, or blunt-edged.

Colour grayish, reddish, or yellowish white; translucent; soft; brittle; feels greasy. Spec. grav. 2.723.

Chem. Char.—Effervesces briskly with acids.

Calcareous genus.

Constituent Parts.

Carbonate of lime,	98.11
Silica,	.05
Oxide of iron,	.8
Loss,	1.04
	100.00

Localities, &c.—This mineral is found in Saxony, in a bed of limestone, where it is accompanied with galena; in Norway; and in Cornwall in England.

7. Species. Arragonite.

Arragon Spar, Kirw. i. 87. *L'Arragonite*, Broch. i. 576. *Id.* Haüy, iv. 337.

Exter. Char.—This mineral is always found crystallized in six-sided equiangular prisms, or with two opposite faces broader, to which correspond the two faces of an acute bevelment, which terminates the prism. The edges of the bevelment are also truncated. The crystals are variously grouped, and commonly in the form of a cross; crystals streaked longitudinally; lustre shining or resplendent, vitreous; fracture foliated.

Colour grayish or greenish white; translucent and semitransparent; refraction double; hard, scratches calcareous spar; brittle, and easily frangible. Specific gravity 2.946.

Chem. Char.—Effervesces with acids, and is entirely dissolved. The constituent parts, according to numerous and accurate analysis, are the same as those of calcareous spar; but its superior hardness, diversity of form, and other external characters, have long puzzled chemical philosophers; and it still remains undetermined to what that diversity is owing in this mineral.

Localities, &c.—Arragonite was first found imbedded in foliated and fibrous gypsum, in the province of Arragon in Spain, from which it derives its name. It has been also found in France, the Pyrenees, in Saltzburg, sometimes in an argillaceous schistus, and sometimes in quartz, accompanied by calcareous spar and pyrites.

8. Species. Brown Spar.

Sidero-Calcite, Kirw. i. 105. *Le Spath Brunissant*, Broch. i. 563. *Chaux Carbonatée Ferrifère Perlée*, Hauy, ii. 179.

Exter. Char.—Found massive or disseminated, or in kidney-shaped, globular, or carious pieces; very often crystallized. The forms are lenses or rhomboids, which latter have either convex or concave faces; double pyramids composed of two pyramids with three obtuse faces: simple three-sided pyramids, and oblique six-sided pyramids. The surface of the crystals drusy, rarely smooth; lustre weakly shining or shining; internal lustre shining, pearly, or vitreous; fracture foliated; fragments rhomboidal.

Colour milk-white, grayish, yellowish, or reddish white; bright or brownish red; translucent at the edges;

Calcareous genus.

edges; semihard; brittle, easily frangible; streak grayish white. Spec. grav. 2.83.

Chem. Char.—Becomes black and hard before the blow-pipe, and unless reduced to powder, effervesces slowly with acids.

Constituent Parts.	Bergman.
Carbonate of lime,	50
Oxide of iron,	22
Oxide of manganese,	28
	100

Localities, &c.—Brown spar is found in Bohemia, Saxony, France, Sweden, and Britain. It is usually found in metallic veins.

9. Species. Dolomite.

Id. Kirw. i. 111. *Dolomie*, Brochant, i. 334. *Chaux Carbonatée Aluminifere*, Hauy, ii. 173.

Exter. Char.—Found massive; fracture appears to be foliated; fragments blunt-edged.

Colour grayish or yellowish white; translucent on the edges; semihard; rather difficultly frangible; feels meagre. Spec. grav. 2.85.

Constituent Parts.	Saussure.
Lime,	44.29
Alumina,	5.86
Magnesia,	1.4
Oxide of iron,	.74
Carbonic acid,	46.
Loss,	1.71
	100.00

Chem. Char.—Effervesces slowly in nitric acid.

Phys. Char.—Phosphoresces in the dark by the percussion of a hard body.

Localities, &c.—This stone was first observed by Dolomieu, among the ancient monuments of Rome; and afterwards he discovered similar stones in the mountains of the Tyrol and the Alps. It is found abundantly on St Gothard and other primitive mountains. Dolomieu's attention was first attracted to it by its superior hardness and slow effervescence in acids, and analysis shews that it is different from limestone in its composition.

10. Species. Rhomb or Bitter-Spar.

Crystallized Muricalcite, Kirw. i. 92. *Le Spath Magnesien*, Brochant, i. 560. *Chaux Carbonatée Magnesifere*, Hauy, ii. 187.

Exter. Char.—Found massive, or disseminated in rhomboidal pieces, which have a crystallized appearance; lustre shining or resplendent, and vitreous or pearly; fracture foliated; cleavage threefold; fragments rhomboidal.

Colour grayish white, yellowish or reddish brown; translucent at the edges; semihard; brittle; streak snow-white. Spec. grav. 2.48.

Chem. Char.—Becomes gray or brown before the blow-pipe without splitting or fusion. Effervesces a little with acids.

Classification.

Constituent Parts.	Klaproth.	
Carbonate of lime,	52	73
——— magnesia,	45	25
Oxide of iron and manganese,	3	2
	100	100

Localities, &c.—Found in the Tyrol and Saltzburg, and in Sweden. It is always accompanied with asbestus, talc, and tremolite, and imbedded in chlorite schistus, serpentine, and indurated talc.

11. Species. Swine Stone.

Id. Kirw. i. 89. *La Pierre Puante*, Brochant, i. 567. *Chaux Carbonatée Fœtide*, Hauy, ii. 288.

Exter. Char.—Found massive; internal lustre glimmering or dull; fracture splintery, sometimes earthy or foliated; fragments splintery.

Colour grayish black, or blackish brown; opaque, rarely translucent at the edges; streak grayish white; semihard, sometimes soft; easily frangible. Spec. grav. 2.71.

Phys. Char.—When rubbed with a hard body, it gives out a very fœtid odour of rotten eggs.

Chem. Char.—Soluble with effervescence in nitric acid; before the blow-pipe is deprived of its odour, which is supposed to be owing to sulphurated hydrogen.

Localities, &c.—Forms entire beds in stratiform limestone rocks, as in France, Saxony, and Sweden.

12. Species. Marl.

This is divided into two subspecies; 1 earthy; and, 2 indurated.

Subspecies 1. Earthy Marl.

Id. Kirw. i. 74. *La Marne Terreuse*, Brochant, i. 569. *Argile Calcarifere*, Hauy, iv. 455.

Exter. Char.—This variety is composed of loose or slightly coherent particles; stains a little; feels meagre and rough; is light; almost swims on water.

Colour yellowish gray, or grayish white.

Localities, &c.—Found in many places of France and Germany, as well as in different places of England and Scotland, forming beds in limestone countries, and often immediately under the soil.

Uses.—It is sometimes employed in the manufacture of pottery, but its principal use is for the purposes of agriculture.

Subspecies 2. Indurated Marl.

Id. Kirw. i. 95. *La Marne Endurcie*, Brochant, i. 571.

Exter. Char.—Found massive, dull, or slightly glimmering; fracture earthy, splintery, or slaty; fragments blunt-edged.

Colour yellowish, or smoke gray; opaque; streak grayish white; soft; not very brittle; easily frangible. Spec. grav. 1.6 to 2.8.

Chem.

Classification.

Chem. Char.—Melts before the blow-pipe into a grayish black slag; effervesces briskly with acids.

Marl is considered as a mixture of carbonate of lime and alumina; and according to the different proportions of these ingredients, it is denominated calcareous marl or clay marl, and sometimes it is known in agriculture by the names of soft and hard marl.

Localities, &c.—Found in Bohemia, Saxony, Sweden, Italy, France, and Britain, in stratiform mountains, sometimes in extensive beds, frequently accompanying limestone, coal, and basalt.

Uses.—It is employed in agriculture for improving the soil, sometimes for building, and sometimes as a limestone. It serves also as a flux for some ores of iron.

13. Species. Bituminous Marl Slate.

Marno-bitumineux, Brochant, i. 574. *Chaux Carbonatée Bituminifere*, Hauy, ii. 189.

Exter. Char.—Found massive; surface rough, dull, rarely glimmering; or when divided into curved plates, smooth and shining; fracture slaty; straight or waved; fragments tabular.

Colour grayish or brownish black; opaque; streak shining; soft; easily frangible; feels rather meagre.

Chem. Char.—Effervesces with acids; inflames before the blow-pipe; gives out a bituminous odour, and then melts into a black slag.

Localities, &c.—Found in different places of Thuringia, in mountains of stratiform limestone, forming particular beds, which repose frequently on a species of sandstone. It is frequently mixed with different ores of copper, so that it is sometimes wrought as a copper ore. In this bituminous schistus, petrified fishes and marine plants are frequently found, disposed in regular order, from which some have conjectured that they must have died a violent death; or, according to others, that they have been poisoned by the copper with which it abounds.

14. Species. Apatite.

Phospholite, Kirw. i. 128. *L'Apatite Commune*, Brochant, i. 580. *Chaux Phosphatée*, Hauy, ii. 234.

Exter. Char.—Found almost always crystallized, rarely disseminated. The forms of its crystals are, 1. A regular six-sided prism; 2. The same prism truncated on its lateral edges; 3. Also on its angles and terminal edges; 4. Bevelled on each of the lateral edges; 5. With an obtuse and regular six-sided pyramid, and one or both extremities, the summit being slightly truncated; 6. A three-sided prism with the lateral edges bevelled, and the terminal edges truncated; 7. A six-sided table, having its terminal edges strongly, and the lateral edges slightly truncated. Lateral faces of the prisms longitudinally streaked; faces of the pyramid smooth; lustre shining and resplendent; internal lustre shining, between resinous and vitreous. Cross fracture foliated; in other directions fine grained, uneven, or conchoidal. Fragments rather sharp-edged.

Colour green of various shades, blue, sometimes pearl gray, and greenish gray; semitransparent, sometimes transparent, or only translucent; semihard; is scratched by fluor spar; brittle, and easily frangible. Spec. grav. 2.8 to 3.2.

Chem. Char.—Thrown on hot coals it gives out a greenish phosphorescent light; infusible before the blow-pipe, but loses its colour. It is almost entirely soluble in nitric acid. Calcareous genus.

Constituent Parts.	Klaproth.
Lime,	55
Phosphoric acid,	45
	100

Phys. Char.—Becomes electric by friction, but not by heat.

Localities, &c.—Apatite is found in different places of Germany, chiefly in tin mines, where it is accompanied by fluor spar, quartz, and metallic ores. It is also found in Cornwall in similar circumstances.

15. Species. Asparagus Stone.

La Pierre d'Asperge, Broch. i. 586. *Chaux Phosphatée*, Hauy, ii. 234.

Exter. Char.—This mineral has been only found crystallized in equiangular six-sided prisms, terminated by a slightly obtuse six-sided pyramid; lateral edges sometimes truncated; lateral faces longitudinally streaked, the others smooth; external lustre shining or resplendent; internal, resplendent and resinous; fracture foliated, cross fracture imperfectly conchoidal; fragments not very sharp-edged.

Colour asparagus green, greenish white; commonly transparent, often only semitransparent, or even translucent; semihard. Spec. grav. 3.09.

Chem. Char.—Infusible before the blow-pipe; soluble with effervescence in nitric acid, but thrown on hot coals does not phosphoresce.

Constituent Parts.	Vanquelin.
Lime,	53·32
Phosphoric acid,	45·72
Loss,	·96
	100.00

Localities, &c.—This stone has been found at Caprera, near Cape de Gates in Spain, and also, it is said, near Arendal in Norway.

16. Species. Phosphorite.

L'Apatite Terreuse, Broch. i. 584. *Chaux Phosphatée Terreuse*, Hauy, ii. 239.

Exter. Char.—Found massive, and having little coherence; dull; fracture earthy, or fine grained uneven; fragments blunt-edged, sometimes wedge shaped.

Colour yellowish or grayish white; opaque; semihard; often friable; easily frangible; feels meagre. Spec. grav. 2.82.

Chem. Char.—Before the blow-pipe it phosphoresces, and according to some, melts into a white glass, but according to others, infusible. Soluble in acids, and with sulphuric acid gives out white vapours.

Calcareous genus.

Constituent Parts.	Pelletier.
Lime,	59.
Silica,	2.
Phosphoric acid,	34.
Fluoric acid,	2.5
Carbonic acid,	1.
Muriatic acid,	.5
Oxide of iron,	1.
	100.0

Localities, &c.—This mineral is found in the north of Scotland, and in the province of Estremadura in Spain, where it forms an entire mountain. It is mixed with quartz; has been long known by the inhabitants of the country for its property of phosphorescing when thrown on hot coals.

17. Species. Fluor.

This has been divided into three subspecies: 1. earthy; 2. compact; and, 3. fluor spar.

Subspecies 1. Earthy Fluor.

Sandy or *Earthy Fluor*, Kirw. i. 126. *Le Fluor Terreux*, Broch. i. 593. *Chaux Fluaté Amorphe*, Hauy, ii. 260.

Exter. Char.—Is composed of particles which are slightly cohering; dull, or scarcely glimmering.

Colour greenish white, sometimes bluish green; stains a little; feels rough.

Chem. Char.—Thrown on hot coals, it gives out a bluish green light.

Localities, &c.—Has been found in Hungary, in a vein accompanied with quartz.

Subspecies 2. Compact Fluor.

Id. Kirw. 127. *Id.* Broch. i. 594.

Exter Char.—Is found massive; dull, lustre sometimes glimmering, vitreous; fracture even, conchoidal, and rarely splintery; fragments sharp-edged.

Colour greenish gray, or greenish white; sometimes different colours are disposed in spots; translucent; streak shining; hard, and brittle.

Chem. Char.—Phosphoresces on hot coals.

Localities, &c.—This mineral is found in the Hartz, in Sweden, and Siberia, always accompanying fluor spar.

Subspecies 3. Fluor Spar.

Foliated or *Sparry Fluor*, Kirw. i. 127. *Le Spath Fluor*, Broch. i. 595. *Chaux Fluatée*, Hauy, ii. 247.

Essen. Char.—Insoluble in water, and divisible into a regular octahedron.

Exter. Char.—Fluor spar is found massive or disseminated, but most frequently crystallized. Primitive form a regular octahedron, which is easily obtained by mechanical division; integrant molecule a regular tetrahedron. The usual forms are, 1. The cube, which is either perfect, or with truncated edges or truncated angles, or with the edges bevelled, having on each of its angles a three-sided pyramid, corresponding to the faces of the cube. 2. The octahedron, which is either perfect, or has its angles or its edges, or both, truncated. Surface of the crystals smooth, shining or resplendent, sometimes drusy; internal lustre shining, resplendent, and vitreous or pearly; fracture foliated, straight or curved; cleavage fourfold, in the direction of the faces of the regular octahedron; fragments tetrahedral, or rhomboidal.

Classification.

Colours of fluor spar extremely various and beautiful. The principal are, greenish white, grayish, or yellowish; blue, green, brown, and red, of various shades; and different colours are sometimes arranged in stripes and spots. Most commonly translucent, sometimes transparent, or only translucent at the edges. Semihard; brittle; easily frangible. Spec. grav. 3.09 to 3.19.

Chem. Char.—Fusible before the blow-pipe into a transparent glass; decrepitates when heated. The powder thrown on hot coals gives out a bluish or greenish phosphorescent light; and two pieces rubbed against each other, shine in the dark.

Constituent Parts.	Scheele.
Lime,	57
Fluoric acid,	16
Water,	27
	100

Localities, &c.—Fluor spar is sometimes found in beds, but most frequently in mineral veins. It is very common in many places of the world, particularly in Cornwall and Derbyshire, and also in the counties of Durham and Cumberland in England; at Chamouni in Savoy, the octahedral variety of a rose red colour is found. Fluor spar is found also in the interior part of Aberdeenshire in Scotland.

Uses.—This mineral is successfully employed as a flux for different metallic ores. As it is susceptible of a fine polish, it is cut and formed into a great variety of ornamental objects, as pyramids, vases, &c. which, on account of the beauty of the colours, are greatly esteemed.

18. Species. Gypsum.

This species is divided into four subspecies: 1. earthy; 2. compact; 3. foliated; and, 4. fibrous.

Subspecies 1. Earthy Gypsum.

Farinaceous Gypsum, Kirw. i. 120. *Le Gypse Terreux*, Broch. i. 601. *Chaux Sulphatée Terreuse*, Hauy, ii. 278.

Exter. Char.—This is composed of particles which are more or less cohering; dull, in some places weakly glimmering; feels meagre and rough.

Colour white, gray, or yellowish.

Localities, &c.—This substance is rare; it is only found in the fissures and cavities of gypsum rocks, and is supposed to be a deposition of loose particles of gypsum, carried along by water. Found in Saxony, and Monte Martre near Paris.

Subspecies

Classification.

Calcareous genus.

Subspecies 2. Compact Gypsum.

Id. Kirw. i. 121. *Id.* Broch. i. 602. *Id.* Hauy, ii. 278.

Exter. Char.—Found massive; lustre weakly glimmering, almost dull; fracture compact, even, or splintery; fragments blunt-edged.

Colour yellowish and grayish white, sometimes reddish; and different colours exhibit stripes; translucent at the edges; soft, and easily frangible. Spec. grav. about 2.3.

Localities, &c.—Found in Italy, Germany, France, Spain, and England.

Subspecies 3. Foliated Gypsum.

Granularly Foliated Gypsum, Kirw. i. 123. *Id.* Broch. i. 606.

Exter. Char.—Found massive or disseminated, and sometimes, it is said, erystallized in six-sided prisms, obtusely bevelled at each extremity; lustre glimmering or shining, between vitreous and pearly; fracture foliated, sometimes radiated; fragments blunt-edged.

Colour usually snow white, grayish, yellowish, or reddish white; and several colours are arranged in spots, stripes, and veins. Translucent, rarely semitransparent; refraction double; very soft; easily frangible. Spec. grav. 2.27 to 2.31.

Foliated gypsum has some resemblance to granular limestone, but may be readily distinguished from it by its softness.

Subspecies 4. Fibrous Gypsum.

Id. Kirw. i. 122. *Id.* Broch. i. 604. *Id.* Hauy, ii. 278.

Exter. Char.—This is found massive, but in thin layers; lustre shining, or weakly shining, pearly; fracture fibrous; in some varieties the longitudinal fracture is foliated; cross fracture fibrous; fragments long, splintery.

Colour snow white, grayish, yellowish, or reddish white; translucent; very soft; easily frangible.

Chem. Char.—The different varieties of gypsum possess nearly the same chemical characters. When pure, there is no effervescence with acids. Before the blow-pipe gypsum immediately becomes white, is converted into a white enamel, which, at the end of 24 hours, falls into powder.

Localities, &c.—Gypsum, in general, constitutes mountains or beds, which are subordinate to sandstone, or limestone. It is found in all kinds of rocks. Gypsum is found in great abundance in the neighbourhood of Paris, in several parts of Englaud, but sparingly in Scotland.

Uses.—Gypsum is employed along with lime as a cement. It is also very extensively employed under the name of plaster of Paris, for making casts and models. With this view it is exposed to a strong heat, to drive off the water of crystallization. It is then in the state of powder, which being again mixed with water, is put into the mould in the form of paste; and, from its strong affinity for water, it soon becomes solid.

19. Species. Selenite.

Broad Foliated Gypsum, Kirw. i. 123. *La Selenite*, Broch. i. 609. *Chaux Sulfatée*, Hauy, ii. 266.

Essen. Char.—Divisible into smooth plates, which break under angles of 113° and 67°.

Exter. Char.—Selenite is found massive; and frequently also erystallized. The primitive form of its crystals is a four-sided prism, whose bases are obliquely parallelograms; the integrant molecule is the same. The usual forms are, a six-sided prism, having two broad and two narrow faces, and terminated by an oblique bevelment, whose sides correspond to the broad sides of the prism; a similar prism terminated by a four-sided pyramid; double crystals composed of two of the former united by their smaller lateral faces, so that the summits united form on one side a salient angle, and on the other a reentering angle; another form is a spheroidal or conic lens. These crystals are often gronped, divergent, fascicular, or stellated; and of the six sides of the prism, the two opposite are smooth, and the four others longitudinally streaked; lustre resplendent or shining, between vitreous and pearly; fracture foliated, straight or curved; cleavage threefold; fragments rhomboidal, with two faces smooth and shining, and two others streaked.

Colour usually white, grayish, yellowish, or snow white, sometimes irideseent; transparent, sometimes only translucent; very soft; in thin plates, flexible, but not elastic; easily frangible. Spec. grav. 2.32.

Chem. Char.—Before the blow-pipe more easily fusible than gypsum, and splits into thin plates.

Constituent Parts.	Bergman.
Lime,	32
Sulphuric acid,	46
Water,	22
	100

Localities, &c.—Selenite is found among beds of gypsum, and particularly among those which alternate with clay and sand-stone. It is also found in nests in clay. It is not uncommon in many places, as among the gypsum rocks near Paris, in different parts of England, and at Lord Glasgow's coal works in Scotland, where it is found among clay, and in the cavities or on the surface of the limestone which reposes on the strata of coal.

Uses.—Selenite also, after calcination, is employed in modelling; but it is said that it possesses less solidity than what is obtained from gypsum.

20. Species. Anhydrite.

Chaux Sulfatée Anhydre, Hauy, iv. 348.

Exter. Char.—This mineral is found massive; lustre shining or weakly shining, and pearly; fracture curved foliated, sometimes radiated, and fine splintery: fragments sharp-edged; translucent; semihard; not very brittle, rather easily frangible. Spec. grav 2.964.

Chem. Char.—Before the blow-pipe it neither exfoliates nor becomes white, like selenite.

Constituent

Calcareous genus.

Constituent Parts.

	Vauquelin.	Klaproth.
Lime,	40	42.
Sulphuric acid,	60	57.
Oxide of iron,	—	.1
Silica,	—	.25
Loss,	—	.65
	100	100.00

Localities, &c.—This mineral has been found in Switzerland, in the salt pits in the canton of Berne.

21. Species. CUBE SPAR.

Chaux Sulfatée Anhydre, Hauy, iv. 348. *Saude Muriatcé Gypsifere*, Id. ii. 365. *Muriacite*, Klaproth.

Exter. Char.—This mineral is found massive, and also crystallized, in four-sided prisms, which are nearly cubical; two of the opposite lateral faces are broader than the other two. The lateral edges are sometimes truncated, and hence arises an eight-sided prism: sometimes also the truncations are so great as to destroy the narrow lateral faces, and form again a six-sided prism. External lustre of the broad faces resplendent and pearly; of the narrow, shining. Internal lustre shining and pearly; fracture foliated; cleavage threefold; fragments cubical.

Colour milk-white, grayish, yellowish, and reddish white; sometimes pearl gray; translucent; semihard. Spec. grav. 2.92 to 2.96.

Constituent Parts.	Klaproth.
Sulphate of lime,	57.8
Carbonate of lime,	11.
Muriate of soda,	31.2
	100.0

Localities, &c.—Found in the salt pits at Halle in the Tyrol, where it is called *splintery gypsum*.

22. Species. DATHOLITE.

Chaux Datholite, Brochant, ii. 397. *Chaux Boratée Siliceuse*, Hauy.

Exter. Char.—This mineral has only been found crystallized; the primitive form is a rectangular prism, with rhomboidal bases, whose angles are 109° 18′ and 70° 42′; lustre shining, vitreous; fragments conchoidal.

Colour grayish or greenish white; translucent; scratches fluor spar. Spec. grav. 2.98.

Chem. Char.—In the flame of a candle it becomes dull white, and is easily reduced to powder. Before the blow-pipe it melts into a glass of a pale rose-red colour.

Constituent Parts.	Klaproth.
Lime,	35.5
Silica,	36.5
Boracic acid,	24.
Water,	4.
	100.0

Localities, &c.—Found near Arendal in Norway, and some specimens are accompanied by greenish-coloured, foliated talc. Classification.

VII. BARYTIC GENUS.

1. Species. WITHERITE, or *Carbonate of Barytes.*

Barolite, or *Aerated Barytes*, Kirw. i. 134, *La Witherite*, Brochant, i. 613. *Baryte Carbonatée*, Hauy, ii. 308.

Essen. Char.—Forming a white precipitate in weak nitric acid before solution.

Exter. Char.—Found massive, or disseminated, rarely crystallized; forms of its crystals are, a six-sided prism, with a six-sided pyramid set on the lateral faces; the same prism having all the angles truncated; a double six-sided pyramid. The crystals, which are small, are usually imbedded in the mineral itself; sometimes grouped in bundles, or crossing each other. Surface smooth; lustre of the principal fracture shining, or weakly shining, resinous; fracture between radiated and foliated; cross fracture fine grained uneven; fragments wedge-shaped.

Colour yellowish gray, grayish, or yellowish white; translucent, or semitransparent; semihard, or soft; brittle; easily frangible. Spec. grav. 4.3 to 4.33.

Chem. Char.—Infusible according to Hauy before the blow-pipe; but according to Brochant, melts before the blow-pipe to a white enamel.

Constituent Parts.

	Pelletier.	Vauquelin.
Barytes,	62	74.5
Carbonic acid,	22	25.5
Water,	16	—
	100	100.0

Constituent Parts according to Klaproth.

Carbonate of barytes,	98.246
Carbonate of strontites,	1.703
Alumina iron,	.043
Carbonate of copper,	.008
	100.000

Localities, &c.—This mineral was discovered by Dr Withering at Anglesark in Lancashire, in lead veins, which traverse the coal strata, and it is accompanied with heavy spar and blende.

Uses.—Barytes acts as a strong poison on the animal economy. It has been long employed at Anglesark for the purpose of destroying rats. It has also been tried as a medicine in scrofula, but seemingly with little effect; and it ought to be had recourse to with extreme caution.

2. Species. HEAVY SPAR, or *Sulphate of Barytes.*

This species has been divided into eight subspecies; earthy, compact, granular, foliated, common, columnar, prismatic, and bolognian.

Subspecies 1. EARTHY HEAVY SPAR.

Earthy Baroselenite, Kirwan, i. 138. *Le Spath Pesant Terreux*, Brochant, i. 617.

Classification.

Exter. Char.—Found massive; lustre scarcely glimmering, or dull; consists of earthy particles, which are slightly cohering; stains a little; feels meagre.

Colour snow white, grayish, yellowish, or reddish white.

Localities, &c.—This a rare mineral. It has been found in Saxony, covering masses of heavy spar, and also in Derbyshire and Staffordshire in England.

Subspecies 2. Compact Heavy Spar.

Compacte Baroselenite, Kirw. i. 138. *Baryte Sulfatée Compacte*, Hauy, ii. 303. *Id.* Broch. i. 618.

Exter. Char.—Found massive, sometimes in kidney-form or globular pieces, with cubical impressions; lustre glimmering, sometimes dull, and sometimes weakly shining; fracture coarse earthy, sometimes uneven; fragments not very sharp-edged.

Colour yellowish, grayish white, sometimes pale flesh red; opaque, or translucent at the edges; soft; not very brittle; easily frangible; feels meagre.

Localities, &c.—Found in mineral veins in Saxony, and in England; in clay slate, in Savoy; and we have found it in sand stone in Northumberland.

Subspecies 3. Granular Heavy Spar.

Exter. Char.—This also is found massive; lustre glimmering, nearly shining, and pearly; fracture foliated, or splintery; fragments blunt-edged.

Colour snow-white, milk-white, yellowish, or reddish; translucent; soft; not very brittle; easily frangible. Spec. grav. 3.8.

Constituent Parts.	Klaproth.
Barytes,	60
Sulphuric acid,	30
Silica,	16
	100

Localities, &c.—Found in mineral veins in Saxony, along with galena, and in Siberia, accompanied by copper and silver ores.

Subspecies 4. Foliated Heavy Spar.

Exter. Char.—Found massive, and in kidney-shaped, globular, and cellular pieces, composed of four-sided tables, or lenses, with a drusy surface; lustre glimmering or shining, between pearly and vitreous; fracture curved foliated, sometimes splintery; fragments not very sharp-edged, sometimes wedge-shaped.

Colour yellowish, reddish, or grayish white, sometimes flesh or brownish red; translucent; soft; not very brittle; easily frangible.

Localities, &c.—Is not uncommon in mineral veins; sometimes also in beds, in many countries. It is also found in Britain.

Subspecies 5. Common Heavy Spar.

Foliated Baroselenite, Kirw. i. 140. Broch. i. 624.

Exter. Char.—This mineral is found in masses, or disseminated, and very often crystallized. Its principal forms are, 1. A double four-sided pyramid; 2. A four-sided prism, rectangular or oblique; 3. A four-sided table, rectangular or oblique; 4. A six-sided prism; 5. A six-sided table; and, 6. A long eight-sided table. These forms are variously modified by truncations and bevelments, and they are differently grouped together; the prisms cross one another; the tables are attached by their lateral faces, and form globular or kidney-shaped groups; surfaces smooth, sometimes rough and drusy. Lustre resplendent, shining, glimmering, or only dull: internal lustre shining or resplendent, between pearly and resinous: fracture straight foliated; cleavage threefold; fragments somewhat rhomboidal.

Barytic genus.

Colour commonly white, snow-white, milk-white, grayish, yellowish, or reddish; in masses translucent; in crystals transparent or semitransparent; refraction double; soft; brittle. Spec. grav. 4.29 to 4.47, and 4.5.

Chem. Char.—Fusible before the blow-pipe into a solid white enamel, which being moistened, gives out the odour of sulphurated hydrogen. Does not effervesce with acids.

Constituent Parts.

	Withering.	Bergman.
Barytes,	67.2	84
Sulphuric acid,	32.8	13
Water,	–	3
	100.0	100

Localities, &c.—This is a very common mineral, and particularly in metallic veins that traverse primitive mountains. It accompanies ores of silver, copper, lead, and cobalt, as well as fluor spar, calcareous spar, and quartz.

Subspecies 6. Columnar Heavy Spar.

Le Spath Pesant en Barres, Broch. i. 631. *Baryte Sulphatée Bacillaire*, Hauy, ii. 302.

Exter. Char.—Found always crystallized: 1. In oblique four-sided prisms; 2. The same prism terminated by an acute bevelment; 3. The same prism terminated by a four-sided pyramid placed on the lateral edges, and, 4. A six-sided prism bevelled at the extremity. The crystals are acicular, and are grouped together in bundles; surface shining, or weakly shining; internal lustre shining; longitudinal fracture radiated; cross fracture even. Fragments rhomboidal.

Colour silvery, grayish or greenish white; translucent; soft, and brittle.

Localities, &c.—Found in Saxony, and Derbyshire in England, accompanied by other varieties of heavy spar, quartz, and fluor spar.

Subspecies 7. Prismatic Heavy Spar.

Exter. Char.—Found massive, and frequently crystallized. The usual forms are, 1. An oblique four-sided prism, bevelled at the extremities; 2. An oblique four-sided prism, terminated by a four-sided pyramid placed on the lateral edges; 3. An elongated octahedron; and, 4. A six sided prism. Lustre shining or resplendent, between resinous and pearly: fracture foliated; cleavage threefold.

Colour

Strontian genus.

Colour yellowish, greenish, or pearl gray, sometimes pale blue, and rarely flesh red; translucent; when crystallized, transparent; soft, and not very brittle; very easily frangible.

Localities, &c.—Sometimes found in mineral veins, as in Saxony.

Subspecies 8. Bolognian Heavy Spar.

Le Spath de Bologne, Brochant, i. 633. *Striated* or *fibrous heavy spar*, Kirwan, i. 141. *Baryte sulfatée radiée*, Hauy, ii. 302.

Exter. Char.—This is found in rounded pieces; external surface uneven, dull, or glimmering; internal lustre shining, or weakly shining, between adamantine and pearly; fracture radiated, parallel, diverging, or fibrous, sometimes foliated; fragments splintery, sometimes rhomboidal.

Colour, smoke or yellowish gray; translucent, soft, very brittle, and easily frangible.

Chem. Char.—This mineral has been long known by its property of shining in the dark, after being heated. Other heavy spars, indeed, have a similar property.

Constituent Parts.	Arvidson.
Sulphate of barytes,	62.
Silica,	15.
Alumina,	14.75
Gypsum,	6.
Oxide of iron,	.25
Water,	2.
	100.00

Localities, &c.—This mineral is found at Monte Paterno near Bologna in Italy, in rounded masses, which have an uneven surface: they are imbedded in an argillaceous or marly rock, which is a kind of amygdaloid, and from which they are detached by the action of the waters.

VIII. STRONTIAN Genus.

1. Species. Strontites, *Carbonate.*

La Strontianite, Brochant, i. 637. *Id.* Kirw. i. 332. *Strontiane Carbonatée*, Hauy, ii. 327.

Essen. Char.—Soluble in nitric acid with effervescence; paper dipped in the solution, and dried, burns with a purple flame.

Exter. Char.—Found massive, and sometimes crystallized in needles, which are grouped together; form of the crystals a regular six-sided prism; lustre weakly shining, or only glimmering; internal lustre shining, and weakly shining, between resinous and pearly; fracture radiated, straight, diverging, or fibrous; cross fracture fine grained, uneven, or splintery; fragments wedge-shaped, or sharp-edged.

Colour asparagus green, greenish, whitish, or yellowish gray; translucent; semihard, brittle and easily frangible; feels a little greasy. Spec. grav. 3.4 to 3.67.

Chem. Char.—Before the blow-pipe whitens without fusion, and afterwards exposed to the air, falls to powder.

Constituent Parts.	Klaproth.	Pelletier.
Strontites,	69.5	62
Carbonic acid,	30.	30
Water,	.5	8
	100.0	100

Classification.

Localities, &c.—This mineral has been hitherto found only at Strontian in Scotland, in a lead vein which traverses a gneiss rock. It is said also to have been found at Leadhills.

2. Species. Celestine, *Sulphate of Strontites.*

La Celestine, Brochant, i. 640. *Strontiane sulfatée*, Hauy, ii. 313.

Essen. Char.—Divisible into a rhomboidal prism, with angles of about 105° and 75°; gives a light red colour to the blue part of the flame produced by the blow-pipe.

Exter. Char.—Primitive form of its crystals a rectangular prism, whose bases are rhombs; integrant molecule a triangular prism with square bases. The forms under which it generally appears are four or six-sided prisms, which are terminated by a two-sided bevelment, a four-sided, or an eight-sided pyramid.

This species has been divided into two subspecies: 1. fibrous; and, 2. foliated.

Subspecies 1. Fibrous Celestine.

Exter. Char.—Found massive or crystallized; lustre of the longitudinal fracture shining; that of the cross fracture, weakly shining between pearly and resinous. Longitudinal fracture foliated; cross fracture fibrous, curved; fragments splintery; rather blunt-edged.

Colour indigo blue, bluish gray, and sometimes with whitish bands, or with yellowish brown spots; translucent; soft, and easily frangible. Spec. grav. 3.83.

Constituent Parts.	Klaproth.
Strontites,	58
Sulphuric acid and oxide of iron,	42
	100

Localities, &c.—Has been found in Pennsylvania in America, and near Toul in France.

Subspecies 2. Foliated Celestine.

Exter. Char.—This is also found massive and crystallized; lustre weakly shining, or shining; that of the crystals resplendent; fracture foliated, straight, or radiated; cleavage threefold.

Colour milk-white, grayish, and bluish-white: semitransparent, or translucent; semi-hard; very easily frangible.

The following are the constituent parts of a variety of sulphate of strontites, which is found at Mont Martre near Paris.

Sulphate of strontites,	91.42
Carbonate of lime,	8.33
Oxide of iron,	.25
	100.00*

* *Vauquelin, Jour. de Mines*, N° 53. *Localities*, p. 355.

Classification.

Localities, &c.—This variety is found in great abundance near Bristol in England, where the sulphate of strontites was first discovered by Mr Clayfield. It has been since found in Sicily, where it is accompanied with fibrous gypsum and native sulphur.

SECOND CLASS. *SALTS.*

I. Genus. SULPHATES.

1. Species. Native Vitriol.

Mixed vitriol, or *sulphate of iron, copper and zinc.* Kirwan, ii. 24. *Vitriol Natif*, Brochant, ii. 2.

Exter. Char.—This mineral is found massive or disseminated, and also in a stalactitical, cylindrical, and capillary form; internal lustre shining, or weakly shining, between silky and vitreous; external surface rough and uneven; fracture usually fibrous, sometimes foliated.

Colour grayish, or yellowish white, sometimes different shades of sky blue; the colour varies by exposure to the air. Soft; semi-transparent or translucent; taste sour and astringent.

Chem. Char.—These are different, according to the proportions of the constituent parts. Before the blowpipe, sulphurated hydrogen gas is given out; the iron is detected by giving a black colour to the solution of nut galls; the copper, by immersing a plate of iron; and the zinc, by a white efflorescence, which appears when the native salt is exposed to the air.

This substance is a mixed salt, composed of the sulphates of iron, zinc and copper, in variable proportions, so that its appearance and characters must also be variable.

Localities, &c.—Native vitriol is not uncommon in mountains of clay slate which contain metallic ores, and particularly those of copper and iron pyrites, and blende; by the decomposition of which it is formed. It is found in Bohemia, Saxony, and Hungary, as well as in the mines of Britain, where such metallic ores abound.

The native sulphate of iron is common in coal mines which contain iron pyrites, as in many of the coal mines of Britain. The substance is very abundant in the earl of Glasgow's coal mines near Paisley, where the manufacture of copperas, by purifying and crystallizing the native salt, has been long carried on.

Uses.—The mixed substance, native vitriol, can only be employed to any useful purpose, by obtaining the different salts in a separate form. The uses of these salts are well known in various arts, but particularly in dyeing, and some of them in medicine.

2. Species. Native Alum.

Alum, Kirwan, ii. 13. *L'Alun Natif*, Brochant, ii. 6. *Alumine Sulfatée alkaline*, Hauy, ii. 387, 388.

Exter. Char.—Native alum is usually found in small capillary crystals, sometimes adhering to other minerals, and very rarely in stalactitical masses. The form of the crystal of alum is the regular octahedron, which is usually obtained artificially. Externally it is dull, or slightly glimmering, but internally shining, with a silky or vitreous lustre, fracture fibrous; very soft; taste astringent. Salts.

Chem. Char.—Before the blow-pipe melts easily in its water of crystallization, then froths up, and becomes a white spongy mass.

Alum is a triple salt, a sulphate of alumina and potash. It rarely happens that all the three ingredients exist together in nature. The potash is usually added during the preparation of artificial alum.

According to the examination of native alum by Klaproth, from the alum cavern at Cape Miseno near Naples, it appears that from 1000 lbs. of the material furnished by nature, 470 lbs. may be obtained, having the requisite quantity of potash; and by an addition of potash to promote the crystallization, 290 lbs. more may be obtained. *Analyt. Ess.* i. 268. The following is the analysis of the aluminous schistus from Freyenwalde by the same chemist.

Alumina,	15.25
Oxide of iron,	7.50
Potash,	.25
Sulphuric acid and water of crystallization,	77.
	100.00*

* *Analyt. Ess.* ii. 78.

Localities, &c.—Native alum is found in those places where the aluminous stones, already described, abound, as in the neighbourhood of volcanoes, and in coal mines. An extensive alum manufactory has been carried on for several years with great skill and success, at Lord Glasgow's coal work near Paisley, mentioned above. The materials are obtained from the rubbish in the old wastes, which consists of the aluminous schistus from the roof and pavement of the coal. These mines also abound with iron pyrites; and from the decomposition of all these substances the native vitriol and native alum are obtained.

Uses.—The uses of alum in various arts are too well known to require any enumeration.

3. Species. Mountain Butter.

La Beurre de Montagne, Broch. ii. 10.

Exter. Char.—Found massive; internal lustre strongly glimmering, waxy; fracture foliated; fragments blunt-edged.

Colour grayish white, sulphur yellow, or yellowish brown; translucent at the edges; feels greasy; taste astringent.

Localities, &c.—This species is found in similar situations with the former. In its native repository it is nearly as soft as butter, and has something of the appearance, from which it has its name. Perhaps it ought to be considered merely as a variety of the former. The same remark may be applied to another variety called *plumose alum*.

4. Species. Capillary Salt. *Sulphate of Magnesia.*

Le Sel Capillaire, Broch. ii. 8. *Haar Salz*, or *Hair Salt*, of the Germans.

Exter. Char.—This salt is always found in fine capillary crystals, so closely united together as to form a compact mass; lustre shining, or weakly shining, silky; fracture fibrous.

Salts.

Colour white, sometimes greenish, grayish, or yellowish; translucent, friable; taste astringent.

Constituent Parts.—This salt was supposed to be a plumose or native alum; but it appears from the analysis of Klaproth, to be a sulphate of magnesia, with a small proportion of iron. We have examined a similar capillary salt from the coal mines near Paisley, which also appeared to be a sulphate of magnesia, but with a greater proportion of sulphate of iron.

Localities, &c.—This native salt is found in similar situations with the former species.

5. Species. NATIVE EPSOM SALT, or *Sulphate of Magnesia.*

Le Sel amer Natif, Broch. ii. 11. *Epsom Salt*, Kir. ii. 12.

Exter. Char.—The characters already given of the former species are equally applicable to this, excepting that it is said to exist sometimes in an earthy form, when it has a dull appearance.

Localities, &c.—Found in a state of efflorescence on limestone, porphyry, sandstones; and it exists in solution in many mineral waters, as in that of Epsom in England, from which it has its name. This salt also constitutes part of the efflorescence which is observed on walls built with lime.

6. Species. NATIVE GLAUBER SALT, or *Sulphate of Soda.*

Glauber Salt, Kirw. ii. 9. *Le Sel de Glauber Natif*, Broch. ii. 14.

Exter. Char.—This salt is sometimes found massive or earthy, rarely stalactitical or crystallized. The crystals are often acicular, or in irregular, six-sided prisms, terminated by a three-sided pyramid, placed on the lateral edges or sides. Lustre shining, vitreous; but exposed to the air becomes dull. Fracture uneven; that of the crystals conchoidal. Fragments blunt-edged.

Colour yellowish or grayish white; opaque or transparent; brittle; taste cooling or bitter.

Localities, &c.—This salt is usually found in the neighbourhood of mineral springs which hold common salt in solution, from the decomposition of which, and the combination of its base with sulphuric acid, it is obtained. It is not unfrequent on the banks of salt lakes, and in a state of efflorescence on sandstone, marl, sometimes on the surface of the ground, and sometimes on walls built with stone and mortar. It is found in most countries in the world.

II. GENUS. NITRATES.

1. Species. NATIVE NITRE, or *Nitrate of Potash.*

Nitre, Kirw. ii. 25. *Le Nitre Natif*, Broch. ii. 17. *Potasse Nitratée*, Hauy, ii. 346. *Saltpetre.*

Essen. Char.—Does not deliquesce, and detonates with a combustible body.

Exter. Char.—This salt is commonly found superficial, in acicular crystals, rarely massive, and more rarely crystallized in six-sided prisms; lustre shining, vitreous; fracture conchoidal; fragments sharp-edged.

Colour snow white, grayish or yellowish white; translucent; soft; easily frangible or friable; taste saline, cooling. Classification.

Constituent Parts.	Klaproth.
Nitrate of potash,	42.55
Muriate of potash,	.20
Sulphate of lime,	25.45
Carbonate of lime,	30.40
Loss,	1.40
	100.00*

* *Analyt. Ess.* i. 270.

Exter. Char. &c.—Native nitre is found in Italy near Molfetta, in Naples, from which that analyzed by Klaproth was obtained, and which is disposed in small beds, or more rarely in veins, on limestone. Native nitre is also not uncommon in Hungary, Spain, France, and Peru, in which latter country, and in the East Indies, where it is very abundant, it is found efflorescent on the surface of the ground at certain seasons of the year.

Uses.—The uses of nitre for some economical purposes, in various arts, in medicine, but particularly in the manufacture of gunpowder, are well known.

III. GENUS. MURIATES.

1. Species. ROCK SALT.

Common Salt, Sal Gem, Kirw. ii. 31. *Le Sel de Cuisine*, Broch. ii. 20. *Soude Muriatée*, Hauy, ii. 356.

Essen. Char.—Soluble in water, and divisible into cubes.

This species is divided into two subspecies: 1. foliated, and 2. fibrous rock salt.

Subspecies 1. FOLIATED ROCK SALT.

Le Sel Gemme Lamelleux, Broch. ii. 21. *Lamellar Sal Gem*, Kirw. ii. 32. *Soude Muriatée, Amorphe*, Hauy, ii. 359.

Exter. Char.—Usually found massive in considerable beds, sometimes disseminated in large masses, or kidney-form, stalactitical, or crystallized in perfect cubes; surface of the crystals smooth; lustre shining, vitreous; fracture foliated; cleavage threefold and rectangular; fragments cubic.

Colour grayish, yellowish, or reddish white, flesh or brownish red; transparent or translucent; soft; streak grayish white; taste saline.

Chem. Char.—This salt decrepitates violently when thrown on burning coals.

Constituent Parts.

	Kirwan.	Bergman.
Soda,	35	42
Muriatic acid,	40	52
Water,	25	6
	100	100

The above are the analyses of pure salt; for as it is found in nature, it contains several other ingredients.

Localities, &c.—Foliated rock salt constitutes a peculiar kind of stratiform mountain, in which it usually

Classification. ally alternates with beds of clay, which are more or less penetrated with salt. It is also accompanied with gypsum, sandstone, limestone. It is sometimes also found in veins.

Rock salt is found in most countries of the world; the most celebrated mines are those of Wiliczka, which have been wrought for 500 years. There are mines of this mineral in Poland, Silesia, and in Bavaria and Siberia; at Cordova in Spain it constitutes an entire mountain, four or five hundred feet high. Rock salt is also found in abundance in Cheshire in England. It is found also in Africa, Asia, as well as in North and South America.

Subspecies 2. Fibrous Rock Salt.

Fibrous Sal Gem, Kirw. ii. 32. *Le Sel Gemme Fibreux*, Broch. ii. 25. *Soude Muriatée Fibreuse*, Hauy, ii. 379.

Exter. Char.—This variety is found massive, in small wedge-shaped veins; lustre glimmering, rarely weakly shining; fracture fibrous, curved parallel or divergent; fragments wedge-shaped, with sharp edges.

Colour grayish white, yellowish or pearl gray, lavender blue, violet blue, or flesh red; varies between translucent and semitransparent. The other characters of fibrous rock salt correspond with those of the preceding subspecies, and it is found in similar situations accompanying it.

2. Species. Sea Salt.

This salt can perhaps scarcely be considered as a separate species. It is found on the shores of the ocean, or of salt lakes during the dry seasons of the year, in consequence of the evaporation and diminution of the water which holds it in solution.

Uses.—The various uses of salt in domestic economy and many of the arts are well known.

3. Species. Native Sal Ammoniac.

Sal Ammoniac, Kirw. ii. 33. *Le Sel Ammoniac Natif*, Broch. ii. 27. *Ammoniaque Muriatée*, Hauy, ii. 380.

Essen. Char.—Entirely volatile by the application of heat.

Exter. Char.—Most commonly found in superficial layers, or efflorescent; sometimes also massive or stalactitical, and rarely crystallized. Primitive form of its crystals a regular octahedron; integrant molecule a regular tetrahedron. The crystals are described to be in the form of cubes, six-sided pyramids, and dodecahedral; lustre shining, often only glimmering or dull and vitreous. Fracture even; fragments sharp-edged.

Colour white, grayish, or yellowish; soft, and often friable; taste saline, pungent, and bitter.

Chem. Char.—Very soluble in water, producing a considerable degree of cold; rubbed with lime, gives out a pungent odour of ammonia.

Constituent Parts.	Klaproth.
Muriate of ammonia,	77·5
Sulphate of ammonia,	2.5
	100.0

Localities, &c.—This salt is a volcanic production, and found deposited in the cavities of lava, as on Vesuvius and Ætna, and in the Lipari islands. It is also met with in Iceland, in Persia, and different places of Asia. The substance analyzed by Klaproth was from Tartary. This salt has also been discovered in the neighbourhood of coal mines in Britain, which have been accidentally on fire. Sal ammoniac from Egypt may be considered rather as an artificial production. Salts.

IV. Genus. CARBONATES.

1. Species. Native Soda, or *Carbonate of Soda.*

Natron, Kirw. ii. 6. *L'Alkali Mineral*, Broch. ii. 30. *Soude Carbonatée*, Hauy, ii. 373.

Essen. Char.—Soluble in water, and effervesces with nitric acid.

Exter. Char.—Found in small particles, which are usually in the state of powder; is dull and meagre to the touch.

Colour grayish white, or yellowish gray; taste sharp alkaline.

Chem. Char.—Very fusible before the blow-pipe; the solution renders vegetable blues green.

The following are the constituent parts of Egyptian natron or soda, analysed by Klaproth.

Carbonate of soda,	32.6
Sulphate of soda,	20.8
Muriate of soda,	15.
Water,	31.6
	100.0

Localities, &c.—Native soda is found on the surface of the soil, or on the borders of lakes which evaporate during the summer, in Egypt, where it has been long collected, and known under the name of *natron*. In the neighbourhood of Debreczin in Hungary, it is found efflorescent on a heathy soil; in Bohemia, in decomposed gneiss rock, where it is annually collected in considerable quantity in the spring of the year. Natron is also found near Naples, in Persia, Bengal, and China. It exists also in solution in many mineral waters.

Uses.—This salt is very extensively employed in many arts.

Another variety of native soda has been described. This is in the form of radiated masses, which are composed of acicular crystals. It seems to be a purer carbonate of soda. The following are the constituent parts according to the analysis of Klaproth.

Soda,	37·
Carbonic acid,	38.
Water,	22·5
Sulphate of soda,	2.5
	100.0

2. Species. Native Magnesia, or *Carbonate of Magnesia.*

A pretty pure carbonate of magnesia, discovered by Dr Mitchell; and another which contains an admixture of

Salts. of silica discovered by Giobert, has been already described under the magnesian genus, species 1. which see.

V. Genus. BORATES.

1. Species. Borax.

Id. Kirw. ii. 37. *Borax Natif*, Broch. ii. 33. *Soude Boratée*, Hauy, ii. 366.

Essen. Char.—Taste sweetish; fusible with considerable intumescence into a vitreous globule.

Exter. Char.—This salt is found massive and disseminated, but most frequently crystallized; the forms are a six-sided prism with the two opposite faces broader; the same prism having its lateral edges truncated, or having its too narrow terminal edges truncated; the crystals are usually imbedded in an earthy mass; surface a little rough, sometimes smooth, and usually covered with a white earthy crust; lustre shining, waxy; fracture foliated.

Colour grayish white, yellowish or greenish; semitransparent, or only translucent; refraction double; soft; brittle; greasy to the feel. Spec. grav. 1.740.

Constituent Parts.—When borax is purified, it is a compound of soda and boracic acid; but in its native state it is always contaminated with earthy matters.

Localities, &c.—Borax is brought from Persia and Thibet. According to some travellers, it is got from the waters of a lake by evaporation in the open air; but according to others it is ready formed on the borders of the lake, where common salt is also collected.

Uses.—Borax is still farther purified after it is brought to Europe, for the purposes of employing it in the arts, particularly as a flux in metallurgical operations.

2. Species. Boracite, or *Borate of Magnesia.*

Boracite, Kirw. i. 172. *Id.* Brochant, i. 589.

Exter. Char.—Always found crystallized: 1. In cubes, having the edges and four of the angles truncated; 2. The cube, having all the edges and angles truncated. When these truncations are increased on the edges, a dodecahedron is nearly formed, or when they increase on the angles, the resulting form is an octahedron. Surface of the crystals smooth, sometimes rough; lustre shining or resplendent; internal lustre shining, resinous; fracture conchoidal; fragments sharp-edged.

Colour ash or yellowish gray, grayish or greenish white; semitransparent or translucent, oftener opaque; semihard; rather easily frangible. Spec. grav. 2.56.

Chem Char.—Melts before the blow-pipe, froths up, and yields a yellowish enamel, on which small rough points appear, and are thrown off like sparks by continuing the heat.

Constituent Parts.	Westrumb.
Magnesia,	13.5
Lime,	11.
Silica,	2.
Alumina,	1.
Oxide of iron,	.7
Boracic acid,	68.
Loss,	3.8
	100.0

Phys. Char.—Boracite has the property of becoming electric by heat, and exhibiting both kinds of electricity by opposite points. These electric poles are the extremities of the axes of the cube, each axis giving out at one extremity positive, and at the other negative electricity.

Localities, &c.—This mineral has been only found at Lunebourg in Lower Saxony, in a mountain composed almost entirely of foliated gypsum, in which the detached crystals are imbedded.

VI. Genus. FLUATES.

1. Species. Cryolite, or *Fluate of Soda and Alumina.*

Id. Brochant, ii. 505. *Alumine Fluatée Alkaline*, Hauy, ii. 398.

Exter. Char—Found massive; lustre shining, vitreous; fracture foliated; fragments cubical.

Colour grayish white; translucent; immersed in water, transparent; semihard; streak snow-white. Spec. grav. 2.94.

Chem. Char.—Melts in the flame of a candle, and from its easy fusibility it derives its name. It then becomes hard, and is changed into a slag, which is somewhat elastic. Soluble with effervescence in sulphuric acid, and gives out white vapours that corrode glass.

Constituent Parts.

	Klaproth.	Vauquelin.
Soda,	36.	32
Alumina,	23.5	21
Fluoric acid and water,	40.5	47
	100.0	100

Localities, &c.—Cryolite was brought to Copenhagen from Greenland, but nothing is known of its repository (B).

THIRD CLASS. *COMBUSTIBLES.*

I. Genus. SULPHUR.

1. Species. Native Sulphur.

Id. Kirwan, ii. 69. *Le Soufre Natif*, Brochant, ii. 37.

This species is divided into two subspecies; 1. Common; 2. Volcanic native sulphur.

Subspecies

(B) Boracite and cryolite do not certainly possess all the characters that entitle them to a place among the salts; but as magnesia is the predominant base of the one and soda of the other, it was thought better to introduce them here than to multiply divisions.

Classification.

Subspecies 1. Common Native Sulphur.

Essen. Char.—The sulphurous odour when heated; colour yellow.

Exter. Char.—Sulphur is found massive, disseminated in superficial layers, or crystallized. Primitive form of its crystals is an octahedron, whose sides are scalene triangles; the integrant molecule is an irregular tetrahedron. The usual forms of the crystals are, 1. That of the primitive form, in which two four-sided oblique-angled pyramids are joined base to base, of which the common base is a rhomb, whose two diagonals are as 5 to 4; 2. The same form having its summits truncated; 3. The first form having its summit surmounted by an obtuse four-sided acumination, set on the lateral faces; 4. Or, having the common case truncated; or, 5. Having its obtuse lateral edges truncated; or, 6. Having the obtuse angles of the common base truncated. The crystals are of various sizes, most frequently grouped: surface smooth; lustre resplendent; internal lustre shining, or weakly shining, between resinous and adamantine; fracture fine grained, uneven, sometimes conchoidal or splintery; fragments sharp-edged.

Colour yellow, greenish, or grayish yellow; translucent or semitransparent; refraction double; soft; brittle, and very easily frangible; gives out by rubbing a sulphureous smell. Spec. grav. 19.9 to 2.03.

Chem. Char.—Burns with a peculiar blue flame, and gives out a pungent odour, which is well known.

Native sulphur is not always pure; it is often contaminated with earthy matters.

Phys. Char.—Sulphur becomes electric by friction, and its electricity is negative.

Localities, &c.—Native sulphur is most commonly found in stratiform mountains, chiefly in those of gypsum, marl, and compact limestone, and there it exists in the form of nodules. Found also, but rarely, and in small quantity, in the veins of primitive mountains. Sulphur is found in many countries of the world, as in Poland, Hungary, Switzerland, Spain, and Sicily, where the finest crystals yet known are found.

Subspecies 2. Native Volcanic Sulphur.

Exter. Char.—Found massive, in rounded pieces, stalactitical, cellular, or in thin sublimed layers, sometimes also crystallized in confused groups; internal lustre weakly shining or shining; fracture uneven; fragments blunt-edged.

Colour the same as the former, but inclining sometimes a little towards gray; translucent; in other characters it resembles the preceding.

Localities, &c.—As its name imports, this variety is found near volcanoes, where it is sublimed among the lava. The sulphur of Ætna and Vesuvius chiefly, and also that of Iceland, and of some of the islands in the West Indies, is collected, and forms a very important article in commerce.

Uses.—Sulphur is one of the most valuable substances in various arts. It is employed in the bleaching of woollen stuffs and silks; it forms an essential ingredient in gunpowder, and it is the base of sulphureous and sulphuric acid, which are so extensively employed in tanning, hat-making, dyeing, and other arts and manufactures.

Combustibles.

II. BITUMINOUS Genus.

1. Species. Petroleum, or *Mineral Oil.*

Le Naphte, and *L'Huile Minerale Commune*, Broch. ii. 59. and 60. *Naphtha* and *Petrole*, Kirwan, ii. 42 and 43. *Bitume Liquide Brune, ou Noiratre*, Hany, iii. 312.

Exter. Char.—Found fluid and somewhat viscid.

Colour blackish or reddish brown; almost opaque; feels very greasy; exhales a strong bituminous odour; taste pungent, acid. Spec. grav. 0.708 to 0.854.

Chem. Char.—Burns easily with a dense smoke, and leaves some earthy residue. When exposed to the air it becomes thicker and less fluid.

Its constituent parts are carbone, hydrogen, and a small portion of oxygen.

Localities, &c.—Petroleum is generally found in the vicinity of coal, rising to the surface of the water which flows from coal strata. It is not uncommon in different parts of the world. It is found in Lancashire in England, and at St Catharine's well near Libberton, in the vicinity of Edinburgh.

Naptha, which is considered merely as a purer kind of mineral oil, is found in considerable abundance in different parts of Persia, on the shores of the Caspian sea, in Calabria, Sicily, and America. In 1802, a spring of naphtha of a topaz yellow colour, burning easily, and leaving little residue, with a specific gravity of 0.83, was discovered in the state of Parma in Italy, and afforded such a quantity as to be sufficient to illuminate the streets of Genoa.

Uses.—Naphtha has been sometimes employed in the composition of varnish, in that of fire-works, for the purpose of heating rooms, when it is mixed with a small quantity of earth; and in Persia and other countries it is burnt in lamps as a substitute for oil. Formerly it was employed in medicine as a vermifuge.

2. Species. Mineral Pitch.

This is divided into three subspecies; 1. elastic; 2. earthy; and, 3. slaggy.

Subspecies 1. Elastic Mineral Pitch.

Mineral Caoutchouc, Kirw. ii. 48. *La Poix Minerale Elastique*, Broch. ii. 64. *Bitume Elastique*, Hauy, iii. 313.

Exter. Char.—Found in masses of different sizes, disseminated, sometimes superficial, or stalactitical; lustre dull, rarely glimmering; internal lustre shining, resinous.

Colour brownish black, hair-brown, often veined yellow; translucent at the edges; soft consistence like elastic gum, and also elastic. It gives out the smell of leather. Spec. grav. 0.902 to 1.23.

Localities, &c.—This mineral was discovered in 1785 in the mine of Odin in Derbyshire in England, where it is accompanied with galena, calcareous spar, heavy spar, fluor spar, and blende.

This substance effaces the marks of black lead on paper, like elastic gum; but stains the paper.

Subspecies

Combustibles

Subspecies 2. Earthy Mineral Pitch.

Semicompact Mineral Pitch, or *Maltha*, Kirw. ii. 46. *La Poix Minerale Terreuse*, Broch. ii. 65.

Exter. Char.—Found massive; internally dull; fracture earthy, sometimes uneven; fragments blunt-edged.

Colour blackish brown, sometimes clove brown; streak shining, and darker coloured; very soft; feels greasy; smell bituminous.

Chem. Char.—Burns with much flame and smoke; exhales a strong odour, and leaves carbonaceous and earthy matter.

Localities, &c.—Found in the principality of Neufchatel in Switzerland.

Subspecies 3 Slaggy Mineral Pitch.

Compact Mineral Pitch, Kirw. ii. 46. *La Poix Minerale Scoriacée*, Broch. ii. 66. *Bitume Solide*, Hauy iii. 313. *Asphaltum*, or *Jews Pitch*, of others.

Exter. Char.—Found massive and disseminated, superficial or stalactitical; lustre resplendent, resinous; fracture conchoidal; fragments sharp-edged.

Colour perfectly black, sometimes brownish black; opaque, rarely translucent at the edges; lustre remains in the streak; soft; feels greasy; by rubbing gives out a bituminous odour. Spec. grav. 1.07 to 1.6.

Localities, &c.—This variety frequently accompanies the preceding. It is found at Morsfeld in the Palatinate, at Neufchatel in Switzerland. It is found floating on the surface of the lake Asphaltum in Judea, from which it derives its name of *Jews pitch*. It is there collected by the inhabitants of the country as an object of commerce, and at the same time, it is said to diminish the quantity of noxious vapours which it exhales—so noxious that birds flying over it drop down dead, whence it has the name of *Dead sea*. This variety of mineral pitch is found in other places, sometimes connected with coal and limestone strata, and sometimes with mineral veins. But the island of Trinidad furnishes the greatest quantity of this substance. In that island there is a pitch lake of about four miles in circumference; but it appears from the information of Mr Spon, in a letter to Mr Tobin of Bristol, by whom this information was communicated, along with a number of specimens to Mr Hatchett, that the substance formerly supposed to be mineral pitch, is nothing more than a porous stone impregnated with that substance; so that what was supposed to be an immense lake of mineral pitch or asphaltum, is only the stone of the country impregnated with bitumen. Mr Hatchett thinks this stone may be arranged in the argillaceous genus *.

* *Lin. Trans.* viii. 251.

3. Species. Amber.

Id. Kirw. ii. 65. *Le Succin*, Broch. ii. 69. *Id.* Hauy, ii. 327.

This is divided into two subspecies.

Subspecies 1. White Amber.

Exter. Char.—Found massive, and in rounded pieces; lustre shining or weakly shining; fracture conchoidal; fragments sharp-edged.

Colour yellowish white, or straw-yellow; slightly translucent; soft; easily frangible; by friction, or reducing to powder, it gives out an agreeable odour. Spec. grav. 1.07 to 1.08.

Classification.

Chem. Char.—Burns with a yellow flame, without melting, giving out at the same time a peculiar odour; leaves very little residue.

Subspecies 2. Yellow Amber.

Exter. Char.—Also found in rounded pieces of various sizes; surface rough and uneven; dull, sometimes glimmering; internal lustre resplendent, resinous; sometimes transparent. In its other external and chemical characters, it resembles the preceding.

Phys. Char.—Amber becomes strongly electric by friction, a property known to the ancients. From the Greek and Latin word *electrum*, the term electricity is derived.

Constituent Parts.—Amber is composed of a large proportion of oil, and of a peculiar acid, the succinic, which is obtained by distillation.

Localities, &c.—Amber is found in the vicinity of bituminous wood, but most commonly in the sand on the shores of the ocean, and chiefly on the shores of the Baltic. It is found also in Sweden, France, Italy, and on the east coast of England. Amber frequently contains small parts of vegetables, and entire insects. Of the origin of this substance nothing certain is yet known.

Uses.—The uses of amber for ornamental purposes, are well known. In this country it was formerly in higher estimation than at present. It still forms an important article of commerce in eastern countries.

4. Species. Mellite, or Honey Stone.

Id. Hauy, iii. 335. *La Pierre de Miel*, Broch. ii. 73. *Mellilite*, Kirw. ii. 68.

Exter. Char.—Found usually crystallized, in double four-sided pyramids; the surface smooth and shining; internal lustre resplendent, between resinous and vitreous; fracture conchoidal; fragments rather sharp-edged.

Colour honey yellow, sometimes hyacinth red; transparent or translucent; refraction double; soft; brittle. Spec grav. 1.58 to 1.66.

Chem. Char.—Becomes white before the blow-pipe, and is reduced to ashes, without flame.

Constituent Parts.	Klaproth.
Alumina,	16
Mellitic acid,	46
Water,	38
	100

Phys. Char.—Becomes slightly electric by friction.

Localities, &c.—This mineral is hitherto rare. It has been found only in Switzerland, accompanied with mineral pitch, and at Arten in Thuringia, attached to bituminous wood.

5. Species. Brown Coal.

This is divided into five subspecies; 1. common; 2. bituminous wood; 3. earthy coal; 4. alum earth; 5. moor coal.

Subspecies

Classification.

Subspecies 1. Common Brown Coal.

La Houille Brune, Broch. ii. 47.

Exter. Char.—Found massive; lustre shining, resinous; fracture conchoidal; longitudinal fracture slaty; fragments rather sharp-edged.

Colour brownish black, or blackish brown; streak shining: soft; not very brittle.

Chem. Char.—Burns with a blue-coloured flame, and gives out an odour like that of bituminous wood.

Constituent Parts. Hatchett*.

* *Phil. Trans.* 1804. p. 399.

	Grains.
Water which soon came over acid, and afterwards turbid by the mixture of bitumen,	60
Thick brown, oily bitumen,	21
Charcoal,	90
Hydrogen, carbonated hydrogen, and carbonic acid gases,	29
	200

The above is the analysis of 200 grains of Bovey coal by distillation.

Localities, &c.—This variety is not uncommon in many places of Germany. It is found also at Bovey near Exeter in England, from which it is called *Bovey coal*.

Subspecies 2. Bituminous Wood.

Carbonated Wood, Kirw. ii. 60. *Le Bois Bitumineux*, Broch. ii. 44.

Exter. Char.—Has a ligneous form, and even sometimes the appearance of branches and roots of trees; glimmering in the principal fracture, in the cross fracture, conchoidal; fragments splintery, wedge-shaped, or tabular.

Colour commonly light blackish brown, sometimes wood brown; opaque; streak shining; soft, and easily frangible.

Chem. Char.—Burns with a bright flame, and gives out a sweetish, bituminous smell.

Localities, &c.—This variety is found in the same places with the other varieties of coal, and also in places where the more common kinds of coal are rare, or in small quantity, as in the island of Iceland, where it is known by the name of *surturbrand*; and in the island of Skye in Scotland. It is found also in the coal fields round Edinburgh, and also at Bovey near Exeter, and in various places on the continent.

Subspecies 3. Earthy Coal.

Bois Bitumineux Terreux, Brochant, ii. 45.

Exter. Char.—The consistence of this variety is intermediate between solid and friable; dull, rarely glimmering; fracture earthy.

Colour blackish brown, or liver brown; streak shining; stains; very soft.

Localities, &c.—This is found in Saxony, Bohemia, France, and particularly in the vicinity of Cologne, where it is known by the name of *umber* or *Cologne earth*, which is employed in the fabrication of colours; and from certain varieties which contain pyrites, alum is extracted.

Combustibles.

Subspecies 4. Alum Earth.

This has been already described under the name of *aluminous schistus*, in the argillaceous genus.

Subspecies 5. Moor Coal.

La Houille Limoneuse, Brochant, ii. 48.

Exter. Char.—This variety is found massive, and in extensive beds; internally glimmering; cross fracture even, sometimes flat conchoidal; longitudinal fracture slaty; fragments trapezoidal or rhomboidal.

Colour blackish brown, and brownish black; streak shining; soft, very easily frangible.

Localities, &c.—Moor coal is abundant in Bohemia; it is found also in Transylvania, and chiefly among sandstone, limestone, and trap rocks. It seems to approach nearly to earth coal.

6. Species. Black Coal.

This species is divided into six subspecies; pitch, columnar, slaty, cannel, foliated, and coarse coal.

Subspecies 1. Pitch Coal.

La Houille Piciforme, Brochant, ii. 49.

Exter. Char.—Found massive or disseminated; and sometimes parts of vegetables, such as the branches of trees, are observed. Lustre shining, resplendent, resinous; fracture conchoidal; fragments sharp-edged.

Colour perfect black, and the longitudinal fracture sometimes brownish; soft; easily frangible. Specific gravity 1.3.

Localities, &c.—This is one of the most common varieties of coal, and therefore is found in all coal countries.

Uses.—As it is susceptible of a fine polish, it is employed for various ornamental purposes. The substance known by the name of *jet*, belongs to this variety.

Subspecies 2. Columnar Coal.

La Houille Scapiforme, Brochant, ii. 15.

Exter. Char.—Found massive; in its fracture shining or weakly shining, resinous; fracture more or less perfectly conchoidal; fragments indeterminate.

Colour perfect black, or brownish black. It is composed of distinct concretions, which are columnar, parallel, slightly curved, whose surfaces are smooth and shining; is soft, and easily frangible.

Localities, &c.—This is a very rare variety of coal. It is found in the Meisner, near Almerode, in Hessia, in a basaltic mountain.

Subspecies 3. Slaty Coal.

La Houille Schisteuse, Brochant, ii. 52.

Exter. Char.—Found massive in entire beds; lustre shining, sometimes only weakly shining or glimmering, resinous; principal fracture slaty; cross fracture imperfect conchoidal; fragments in the form of tables; not very sharp-edged.

Colour

Combustibles.

Colour perfect black, often also grayish, rarely brownish black; streak shining; soft, or semi-hard; easily frangible. Specific gravity 1.25 to 1.37.

Localities, &c.—This is the prevailing coal in Britain, as at Newcastle and Whitehaven in England, and in the coal country both in the east and west of Scotland.

Subspecies 4. Cannel Coal.

La Houille de Kilkenny, Brochant, ii. 55. *Id.* Kirwan, ii. 52.

Exter. Char.—Found massive; lustre weakly shining, resinous; fracture commonly conchoidal, sometimes even and foliated; fragments sometimes rhomboidal or cubical.

Colour grayish black; streak shining; soft; easily frangible. Spec. grav. 1.23 to 1.27.

Localities, &c.—This coal accompanies the former in many places of England and Scotland, as at Whitehaven and Wigan in Lancashire in England; in the neighbourhood of Edinburgh; and at Muirkirk, and other places in Ayrshire in Scotland. The coal at Kilkenny in Ireland belongs also to this variety; and from the places where it is found, is called Wigan or Kilkenny coal.

Uses.—Beside being employed as fuel with other kinds of coal, this variety, being susceptible of a fine polish, is cut and formed into various useful and ornamental purposes. It is said that the choir of the cathedral church of Litchfield is covered with plates of this coal alternating with black marble.

Subspecies 5. Foliated Coal.

Le Charbon Lamelleux, Brochant, ii. 54.

Exter. Char.—Found massive; principal fracture resplendent; cross fracture shining; principal fracture more or less foliated; cross fracture somewhat uneven; fragments rhomboidal.

Colour perfect black, and on the sides of the fissures superficial colours appear, like the colours of tempered steel, or those of the peacock's tail; easily frangible.

Localities, &c.—This coal is found at Liege, in Saxony, near Dresden, and in some parts of France.

Subspecies 6. Coarse Coal.

La Houille Grossiere, Brochant, ii. 55.

Exter. Char.—Found massive; is weakly shining, resinous; fracture uneven, or more or less slaty; fragments blunt-edged.

Colour grayish black, sometimes brownish black; streak shining; soft; easily frangible.

Localities, &c.—Accompanies the other kinds of coal, whose localities have been already mentioned.

7. Species. Coal Blende.

This is divided into two subspecies, conchoidal and slaty.

Subspecies 1. Conchoidal Coal Blende.

La Houille Eclatante, Brochant, ii. 50. *Glanz-kohle* of the Germans.

Classification.

Exter. Char.—Found massive, rarely disseminated; lustre shining or resplendent, approaching to metallic; fracture perfectly conchoidal; fragments not very sharp-edged.

Colour iron black, inclining to brown, or exhibiting the superficial colours like tempered steel; soft; easily frangible.

Chem. Char.—Burns without any flame, leaving a white ash.

Localities, &c.—This variety of coal is very rare. It is found at Newcastle, and at Meissiner in Hessia, along with the other varieties of coal.

Subspecies 2. Slaty Coal Blende.

Native Mineral Carbone, Kirw. ii. 49. *La Blende Charbonneuse*, Brochant, ii. 57. *Anthracite*, Hauy, ii. 307.

Exter. Char.—Found massive and disseminated; internal lustre shining, or resplendent, and between metallic and vitreous; fracture more or less perfectly slaty; cross fracture flat conchoidal; fragments sometimes cubic, and sometimes in tables.

Colour perfect black, approaching more or less to iron black, or grayish or bluish black; opaque; stains, but does not write; soft; rather brittle; very easily frangible. Spec. grav. 1.3 to 1.8.

Chem. Char.—Reduced to powder, and heated in a crucible, this coal gives neither a sulphureous nor bituminous smell, and neither sulphur nor bitumen can be obtained from it. After being long exposed to heat, it consumes slowly without flame, and loses during the process about two-thirds of its weight. The residue is of a blackish gray colour, which shows that the combustion has not been complete.

Constituent Parts.

	Panzenberg.	Dolomieu.
Pure carbone,	90	72.05
Silica,	2	13.19
Alumina,	5	3.29
Oxide of iron,	3	3.47
Loss,		8.
	100	100.00

Localities, &c.—This variety has been found in a vein at Schemnitz in Hungary, in Pais de Vaud, in a transported rock, which seems to be intermediate between granite and breccia; at Konigsberg in Norway, where it is accompanied with native silver; in Saxony it forms an entire bed in a mountain of clay slate; also found in the island of Arran, and near Kilmarnock in Scotland.

III. GRAPHITE Genus.

1. Species. Graphite, or Black Lead.

Plumbago, Kirw. ii. 58. *Le Graphite*, Broch. ii. 76. *Fer Carburé*, Hauy, iv. 98.

This species is divided into two subspecies, scaly and compact.

Subspecies 1. Scaly Graphite.

Exter. Char.—Found massive and disseminated; lustre glimmering or shining, metallic; fracture foliated, conchoidal,

Classification. choidal, sometimes uneven or slaty; fragments blunt-edged, sometimes trapezoidal; commonly appears in distinct granular concretions, which are small or fine grained, with a splintery aspect.

Colour intermediate between bluish black and light iron black; sometimes steel gray, or brownish black; opaque; streak shining; stains and writes; soft; easily frangible; feels greasy.

Subspecies 2. Compact Graphite.

Exter. Char.—This subspecies approaches so near to the former in its characters, that it seems difficult to distinguish it. The following characters and circumstances connected with the natural history of graphite, refer to both. Specific gravity 1.987 to 2.456.

Chem. Char.—When exposed to heat in a furnace, it gives out, during combustion, a great proportion of carbonic acid, leaving a residuum of red oxide of iron.

Constituent Parts.

	Berthollet.	Scheele.	Vauquelin.
Carbone,	90.9	90	23*
Iron,	9.1	10	2
Silica,	–	–	38
Alumina,	–	–	37
	100.0	100	100

* *Jour. des Mines*, N° xii. p. 16.

Of the above analysis it must be observed, that the two first by Berthollet and Scheele must have been very pure specimens of graphite; and, on the contrary, the specimens analyzed by Vauquelin must have been very impure, containing so large a proportion of earthy matters, and so small a proportion of the proper ingredients of that mineral.

Localities, &c.—This mineral, which is not very common, is found chiefly in primitive mountains. It is met with in Spain, France, Bavaria, and Hungary. In England at Borrowdale near Keswick in Cumberland; and at Craigman, near New Cumnock, in Ayrshire in Scotland, where it is found in detached masses among rocks nearly similar to those which accompany coal.

Uses.—Graphite or black lead is employed for making pencils. The coarser parts are employed in making crucibles. It is also employed for covering cast iron, such as grates, to defend them from rust; and on account of its unctuous property, it is applied to those parts of machines which are subject to friction, for the purpose of diminishing it.

2. Species. Mineral Charcoal.

This substance, which accompanies the other varieties of coal already described, is of a woody texture, and has therefore a fibrous fracture, with somewhat of a shining and silky lustre. It is usually found in thin layers with the other varieties of coal, and perhaps it might be considered as coal less perfectly formed; but in its characters it agrees so much with the varieties of coal blende, that it seems quite unnecessary to make it a separate species.

FOURTH CLASS. *METALLIC ORES.*

Metallic Ores.

I. PLATINA Genus.

Species. Native Platina.

Id. Kirw. ii. 103. *Le Platine Natif*, Broch. ii. 86. *Platine Natif Ferrifere*, Hauy, iii. 368.

Essen. Char.—Of a silver white colour, and infusible.

Exter. Char.—Platina is found in the form of small flat or rounded grains; surface smooth, with shining metallic lustre; streak resplendent.

Colour light steel gray, or silver white; semi-hard; ductile; flexible in thin plates. Spec. grav. 15.601 to 17.7; but when purified, and hammered, 23, and according to some, 24.

Chem. Char.—Is almost infusible without addition, in the focus of a burning glass, or exposed to the action of oxygen gas. It does not amalgamate with mercury, and is only soluble in nitro-muriatic acid.

Localities, &c.—Platina was first brought to Europe by Don Ulloa in 1748. The repository of this metal is not known, and it has been found only in South America, till lately that it was discovered in gray silver ore from the mine of Guadalcanal in Spain. In the analysis of this ore, Vauquelin found the platina to be in the proportion of $\frac{1}{16}$.

Uses.—Platina is one of the most valuable mineral substances, as, on account of its hardness and infusibility, it may be applied to many of the purposes of gold and iron; and from its properties of being less liable to change when exposed to the air, or to the action of other chemical agents, it answers those purposes in a superior degree.

Platina in its crude state is alloyed with other metallic substances. It has been long known that it is accompanied with particles of iron, gold, and some other substances. It contains also an ore of one of the new metals. This is iridium, which is alloyed with osmium, another new metal, both which were discovered by Mr Tennant. This ore is composed of plates; it is not malleable; its specific gravity is 19.5, and it is not acted on by nitro-muriatic acid, which dissolves platina. Rhodium and palladium, two other new metals, are alloyed with platina.

II. GOLD Genus.

Species. Native Gold.

This species is divided into three subspecies; 1. golden yellow; 2. brass yellow; and, 3. grayish yellow.

Subspecies 1. Golden-yellow Gold.

L'Or Natif, Jaune d'Or, Broch. ii. 89. *Native Gold*, Kirw. i. 93.

Exter. Char.—Gold is found most frequently disseminated, superficial, or in grains; reticulated, dendritical, capillary, or cellular, often in small plates, more rarely crystallized. The forms of its crystals which have been observed, are small perfect cubes, regular octahedrons, dodecahedrons, double eight-sided pyramids, terminated by four-sided summits, placed on the

Metallic Ores.

four lateral edges of the pyramids alternately; but the crystals are small and ill defined; the surface is smooth and resplendent; that of the small plates dusty and shining; that of the grains only strongly glimmering; internal lustre weakly shining, metallic; fracture hackly.

This variety presents the perfect colour of gold. It is soft; perfectly ductile, flexible, but not elastic; streak resplendent. Spec. grav. of pure gold 19.25 to 19.64.

Subspecies 2. Brass-yellow Gold.

L'Or Natif d'un jaune de laiton, Broch. ii. 91.

Exter. Char.—This variety is almost always found disseminated in small particles, or superficial; sometimes also capillary, in small plates, or crystallized in thin six-sided tables.

The colour is that of brass of various shades, according to the proportion of alloy. In other characters it resembles the former, excepting in the specific gravity, which is inferior, owing to the greater proportion of other metals with which it is alloyed.

Subspecies 3. Grayish-yellow Gold.

L'Or Natif d'un jaun grisatre, Broch. ii. 92.

Exter. Char.—This variety is also found disseminated in small flattened grains; surface is not very smooth; almost uneven, and weakly shining.

Colour steel gray, approaching to that of brass: spec. grav. of this variety is greater than the last, but inferior to the first. In other external characters they are the same.

Chem. Char.—Native gold is only soluble in nitro-muriatic acid; platina is also soluble in the same acid, but it is not, like gold, precipitated from its solution by sulphate of iron.

Constituent Parts.—Native gold is not always found pure. It is frequently alloyed with silver or copper, or with both, and sometimes also, it is said, with platina. To these alloys the difference of colour, which is the foundation of the division into three varieties, is owing. The first variety is the purest, containing only a small proportion of silver or copper; the second has a greater proportion of these metals; and the third, it is supposed, is alloyed with a small portion of platina.

Uses.—Gold (on account of its indestructible nature, and its remarkable malleability and ductility), is one of the most important and valuable of the metals for many purposes; but its uses, whether as money, or articles of luxury, are too well known to require enumeration. As pure gold has no great degree of hardness, it is necessary to alloy it with a portion of copper. This is not less than $\frac{1}{24}$ and never more than $\frac{1}{4}$.

Localities, &c.—Gold is chiefly found in primitive mountains, and there it is usually in veins, sometimes disseminated in the rock itself. The accompanying substances are quartz, feldspar, limestone, heavy spar, pyrites, red silver, vitreous silver, and galena. Gold is also mixed with manganese, gray cobalt, nickel, and malachite. Gold has also been found, it is said, in fossil substances, as in petrified wood, penetrated with siliceous earth, a mass of which was dug out at the depth of 50 fathoms, in an argillaceous breccia, or, as is supposed by some, a porphyry with an argillaceous basis, in Transylvania. This is considered as a proof of the more recent formation of gold, as well as the discovery of Patrin, who found native gold surrounded by muriate of silver, in the mine of Zmeof in Siberia. Muriate of silver is supposed to be comparatively a late production.

Classification.

But gold is perhaps more common to alluvial soil; there it is disseminated in grains, along with siliceous, argillaceous, and ferruginous sand, of which certain soils are composed; and also in the sand of many rivers: and it is observed that the gold is most abundant when the waters are at the lowest, and especially soon after floods, which shews that the gold is carried down along with the earthy matters which are swept away by the violence of the current. It has been supposed too, that the gold found in the bed of rivers, has been detached, by the force of the waters, from the veins and primitive rocks traversed by these currents; and according to this opinion, attempts have been made to trace the source of these auriferous sands, in the hope of discovering the native repository of this precious metal; but these attempts have usually failed, for it has been found that the gold is peculiar to the alluvial soil through which the stream is carried, and in which the gold is collected. This point seems to be established by the observations of naturalists. 1. The soil of those plains frequently contains, to a certain depth, and in particular places, particles of gold, which may be separated by washing. 2. The bed of the rivers and auriferous streams yields a greater proportion of gold, after the plains which are traversed by those rivers have been flooded, than in any other circumstances. 3. It has always been observed, that gold is found in the sand of rivers in a very limited space. By examining the sand of these rivers higher up, and nearer to their source, no gold is found; so that if this metal were derived from the rocks, which are swept by the currents, the quantity would be greatest nearest to their sources; but observation has proved the contrary. Thus the river Orco contains no gold, but from Pont to the place where it joins the Po. The Tesin affords no gold till it has traversed Lake Major, where its course must have been retarded, and where all the heavy particles of matter which it carried along with it from the primitive mountains, must have been deposited. The quantity of the gold collected on the Rhine near Strasburg, is greater than what is found near Basle, which is more in the vicinity of the mountains. No gold has been discovered in the sands of the Danube during the first part of its course. Those sands become only auriferous below Efferding. The same remark may be applied to the Ems. The sands of the upper part of this river, which traverses the mountains of Stiria, contain no gold; but from the place where it enters the plain at Steyer, till it joins the Danube, its sands are auriferous, and sufficiently rich to be washed with advantage.

The most of the auriferous sands in all parts of the world, are of a black or reddish colour, and consequently ferruginous. From this circumstance, connected with the gold of alluvial land, some naturalists have inferred, that it is owing to the decomposition of auriferous pyrites. It was observed by Reaumur, that the sand which accompanies gold in most of the rivers, and particularly in the Rhone and the Rhine, is like that of

Classification. Ceylon and Expailly, composed of iron and small grains of rubies, corundum, hyacinth. Titanium also has been discovered. It has been observed besides, that the gold of alluvial soil is purer than that which is immediately obtained from rocks, from which it is supposed that it has a different origin. It does not appear to be certainly ascertained, that gold is found in volcanic soil.

Such are the general facts relative to the repositories of gold. We shall now briefly mention the more remarkable places where gold has been found and collected, beginning with those of Europe.

28 Gold mines of Spain. Spain formerly had mines of gold; the richest was in the province of Asturias, where it was dug out from regular veins. These mines, according to ancient historians, were wrought by the Phœnicians, and afterwards by the Romans; but they have been totally abandoned since the discovery of America, and the mineral riches of that country. The rivers of Spain, as well as the Tagus in Portugal, contain auriferous sand.

29 Of France. The only mine of gold which in modern times has been wrought in France, was discovered in 1781, at Gardette, in the valley of Oysans, department of Isere. This was a regular vein of quartz, traversing a mountain of gneiss, and containing auriferous sulphuret of iron, and some fine specimens of native gold; but it was not sufficiently rich to defray the expence of the operations. Many of the rivers of that country contain auriferous sand, as the Rhone, the Rhine, the Garonne, and others of smaller note; and it is said that gold is also found among the black sand, and particles of morassy iron ore, in the neighbourhood of Paris.

30 Of Piedmont. In Piedmont there are some mines of gold. At the foot of Mount Rosa, veins of auriferous sulphuret of iron have been discovered, traversing gneiss; and although these pyrites do not yield more than 10 or 11 grains of gold in the quintal, it has been found worth while to continue the operations. On the south side of the Apennine mountains, there are several auriferous rivers and soils.

Some of the rivers of Switzerland also contain auriferous sands. Such are those of the Reuss and the Aar.

In Germany the only gold mine which is wrought is in Saltsburg, in the chain of mountains which traverses that country from east to west, and which separates it from the Tyrol and Carinthia.

31 Hungary. But Schemnitz and Cremnitz are the most remarkable places in Europe for mines of gold and auriferous sands. The gold of Schemnitz is accompanied by silver, lead, and iron pyrites, and the matrix is quartz. Auriferous sand is found not only in the bed of the river Neva, but this sand is still richer in the plain through which the river flows. According to De Born, this is a ferruginous sand, lying below a bed of chalk.

In Transylvania the celebrated gold mine of Nagyag is remarkable for having the gold combined with native tellurium. There is also another mine at Felsobanya, the ore of which is an auriferous sulphuret of silver, in a vein of a kind of jasper. The rivers of this country also contain gold. The plain on the banks of the river Moros contains an auriferous sand, which is deposited between two beds, neither of which yields a particle of gold. The upper stratum is vegetable soil, and the lower is composed of schistus.

The mines of Hungary are the only gold mines in Europe which are of any importance. Metallic Ores.

In Sweden gold is obtained from the mine of Edelfors in the province of Smoland. This mine yields native gold, and auriferous iron pyrites. The veins are composed of brown quartz, traversing a mountain of schistose hornstone. The gold is sometimes disseminated in the rock itself. 32 Sweden.

In Greece, the island of Thasos in the Archipelago was celebrated in antiquity for its rich mines of gold. The ancients also, it is said, found abundance of gold in Thrace and Macedonia. 33 Greece

The alluvial soil in several places of the British islands, have also furnished gold. Not many years ago, a considerable quantity of gold was collected in a sandy soil, on the mountains of Wicklow in Ireland. Several masses of native gold, exceeding an ounce in weight, were found in that soil; one weighing 22 ounces was found, which is said to be the largest specimen of native gold found in Europe. 34 Ireland.

It would appear that gold was collected at a very early period in Scotland, and particularly in the mine field of Leadhills; but the most extensive operations were carried on by Bulmer an Englishman, in the time of Queen Elizabeth. The trenches, heaps of soil that had been turned up, and other marks of these operations, yet visible between Leadhills and Elvanfoot, still retain the name of *Bulmer's Workings*, and the place where the gold was washed, is still called the *gold scour*. At that time, it is said, an immense quantity of gold was collected. Not many years ago, similar operations were resumed by the advice of a German; but so far as we understand, the quantity of gold collected was scarcely equal to the expence. The operations during the last attempt were carried on under the superintendance of the late Mr John Taylor, manager of the mines at Wanlockhead; a man of no common sagacity, by which he was enabled to collect many curious facts with regard to the natural history of gold. The gold was found in that country immediately under the vegetable soil; and the method of conducting the operation was, to direct a small stream of water so as to carry this soil along with it, to basons or hollow places, where the water might deposit the matters which had been carried along by its current. The matter deposited was repeatedly washed, till the whole of the earthy substances were carried off. The gold being heaviest, sunk to the bottom, and remained behind. Among other facts which Mr Taylor communicated to us, and which he observed during the progress of these operations he found, that the gold was always most abundant near the top of the lead veins which traverse that country. He was so satisfied of this fact, that he could tell, merely by the quantity of gold increasing, when they approached to a vein; and on the other hand the quantity diminishing as they receded from the vein. This fact shows that there is some connection between metallic veins and the formation or deposition of gold. 35 Scotland.

Gold is still found in the soil of that country; but whether the quantity be less than formerly, or the expence of collecting it, from the difference in the price of labour, greater, the produce is by no means equal to the expences, and therefore searching for gold is now only the employment of the leisure hours of some of the miners.

Metallic Ores.

The whole extent of the continent of Asia furnishes gold, in greater or smaller quantity. Gold is found in several of the mines of Siberia, and particularly in that of Beresof, which yields auriferous pyrites partially decomposed, and disseminated in a vein of quartz. In the southern parts of Asia, many mines, and particularly the sands of the rivers, contain gold. The Pactolus, a small river of Lydia, was celebrated in antiquity for the quantity of gold which it yielded, and it was supposed to be the source of the riches of Crœsus.

36 Asia.

Japan, Formoso, Ceylon, Java, Sumatra, Borneo, the Philippines, and other islands of the Indian Archipelago, are supposed to be rich in gold at this day.

37 Africa.

The greatest quantity of gold which the ancients possessed, beside what was obtained from Spain, was brought from Africa. The gold of Africa, which still forms an important article of commerce, is always in the state of gold dust; a circumstance which shews that it is chiefly extracted from alluvial soil by washing. Little gold is found in the northern parts of Africa; three or four places are remarkable for the quantity of gold which they yield. The first is that part of the country between Darfour and Abyssinia. The gold collected there is brought by the Negroes for sale in quills of the ostrich and of the vulture. It would appear that this country was known to the ancients, who regarded Ethiopia as a country rich in gold; and Herodotus mentions that the king of that country exhibited to the ambassadors of Cambyses, all the prisoners bound with chains of gold.

The second great source of gold dust in Africa is to the south of the great desert Zara, in the western part of that country. The gold is collected in that extensive flat which stretches along the foot of the lofty mountains, among which the rivers Senegal, Gambia, and Niger, have their origin. Gold is found in the sands of all these rivers. Bambouk, which lies to the north-west of these mountains, supplies the greatest part of the gold which is sold on the western coast of Africa; at Morocco, Fez, and Algiers, as well as that which is brought to Cairo and Alexandria in Egypt.

A third region of Africa where gold is abundant, is on the south-east coast, opposite to Madagascar; and it is said that the gold brought from Ophir, in the time of Solomon, was from that part of Africa.

38 America.

America is the richest country of the world, in modern times, in this precious metal. There it is collected in the alluvial soil, and in the beds of rivers, and sometimes, but more rarely, in veins. In Mexico, gold is chiefly found in the numerous silver veins of that country. All the rivers in the province of the Caracas, about 10° north of the equator, furnish gold. In the Spanish part of America, Chili furnishes gold from the alluvial soil, as well as the province of Choco, where it is more abundant; while that of Peru is obtained from veins of quartz, marked with ferruginous spots.

But the greatest quantity of gold of commerce comes from Brazil, where it is collected in the alluvial soil, and in the sand of rivers, and extracted by washing. Gold is found almost everywhere in that country, at the foot of the immense chain of mountains which is nearly parallel with the coast, and which stretches from the 5° to the 30° of S. Lat.

III. MERCURY Genus.

Classification.

1. Species. Native Mercury.

Mercury, Kirw. ii. 223. *Mercure Natif*, Broch. ii. 241. *Id.* Hauy, iii. 423.

Essen. Char.—Remains liquid till the temperature be reduced to 40° below 0 Fahrenheit.

Exter. Char.—Native mercury exists disseminated, in globules of different sizes, in small cavities of other ores of mercury; lustre resplendent, metallic.

Colour shining white, or tin white; opaque; perfectly fluid; does not wet the finger; feels very cold. Sp. gr. 13.568 to 13.581.

Chem. Char.—Volatile before the blow-pipe, without diffusing any perceptible odour.

Native mercury is understood to be pure, and having all the properties of that metal; but it is sometimes amalgamated with a little silver, which destroys its fluidity in a slight degree, and renders it somewhat viscous.

Localities, &c.—Native mercury is usually found along with the other ores of that metal, as at Idria, in Friouli, and at Almaden in Spain; but the great proportion of the mercury of commerce is obtained by distillation from native cinnabar. There is also it is said, a rich mine of native mercury near Guança Velica in Peru.

Uses.—For many purposes mercury is one of the most important of metallic substances. It is extensively employed in metallurgy, in extracting gold and silver from their ores, by the process to be afterwards described, called *amalgamation*. The uses of mercury in gilding, in silvering the backs of mirrors, and in medicine, are well known.

2. Species. Native Amalgam.

Natural Amalgam, Kirw. ii. 223. *L'Amalgam Natif*, Broch. ii. 99. *Mercure Argental*, Hauy, iii. 432.

Essen. Char.—Communicating to copper a silvery colour by friction.

Exter. Char.—This species is rarely found massive, but usually disseminated, or superficial, sometimes imperfectly crystallized. The form of its crystals is the octahedron, dodecahedron, but it is usually found in thin plates or leaves; lustre resplendent, or shining; fracture conchoidal.

Colour between shining or tin white, and silvery white, according to the predominance of the mercury or silver; soft, and partially fluid; brittle, and easily frangible.

Chem. Char.—Exposed to heat the mercury is driven off, and the silver remains behind.

Constituent Parts.

	Heyer.	Cordier.	Klaproth.
Mercury,	75	73	64
Silver,	25	27	36
	100	100	100

Localities, &c.—This mineral is rare, and is met with, according to De Born, in the mines of mercury whose

Classification. Metallic Ores.

whose veins are crossed by veins of silver ores. It is found chiefly at Rosenau in Hungary, in Moersfeld, and Moschellausberg, in the duchy of Deux Ponts, and at Sahlberg in Sweden. It is usually found in a yellowish or reddish ferruginous clay, and accompanied by other ores of mercury.

3. Species. Corneous Ore of Mercury.

Mercury mineralized by the vitriolic and marine acids, Kirw. ii. 229. *Le Mine de Mercure cornée*, Broch. ii. 101. *Mercure muriaté*, Hauy, iii. 447.

Essen. Char.—Colour pearl gray, volatilized by the blow-pipe.

Exter. Char.—Rarely found massive or disseminated, but usually in thin crusts, or in small globules, composed of an assemblage of small crystals, which are either perfect cubes, or six-sided prisms, terminated by a four-sided pyramid; a six-sided prism bevelled at the extremity; or an eight-sided prism with four broad and four narrow alternating faces. Crystals shining, sometimes resplendent; internal lustre shining and adamantine; fracture foliated.

Colour smoke gray, ash gray, or grayish white; translucent; tender, and easily frangible.

Chem. Char.—Entirely volatilized before the blow-pipe, without leaving any residuum, and without decomposition.

The constituent parts are about 70 of mercury, 29 of muriatic acid, and a small portion of sulphuric acid.

Localities, &c.—This mineral has only been known about 13 years, and it is hitherto but rare. It was discovered in the mercury mines of the duchy of Deux Ponts by Woulfe, and has been since found at Almaden in Spain, and at Horsowitz in Bohemia. The repository is in the cavities of a ferruginous clay, which is mixed with malachite and gray copper ore.

4. Species. Liver or Hepatic Ore of Mercury.

Mine de Mercure hepatique, Broch. ii. 104. *Hepatic mercurial ore*, Kirw. ii. 224. *Mercure sulfuré bituminifere*, Hauy, iii. 446.

This is divided into two subspecies, 1. compact, and 2. slaty.

Subspecies 1. Compact Liver Ore of Mercury.

Exter. Char.—Found massive or disseminated; lustre glimmering, metallic; fracture even, sometimes fine-grained uneven; fragments blunt-edged.

Colour between lead gray, and cochineal red; colour of the streak deep cochineal red, and shining; tender, and easily frangible. Sp. gr. 7.18 to 7.93.

Subspecies 2. Slaty Liver Ore of Mercury.

Exter. Char.—Found massive; lustre shining, and resplendent; in the cross fracture glimmering; lustre in general metallic, but sometimes vitreous; principal fracture slaty, in curved thick leaves; cross fracture compact and even; fragments in plates.

Colour of the preceding, but somewhat darker, and approaching to that of iron; opaque; streak shining; powder between cochineal and scarlet red; tender, and very easily frangible.

Localities, &c.—This is the most common ore of mercury in Idria, where it forms considerable beds, and yields about 60 per cent of mercury. It is found also, along with other ores of mercury, in Spain and Siberia.

Liver ore of mercury consists of cinnabar, or the sulphuret of mercury, mixed with a portion of indurated bituminous clay. At Idria it is called *branderz*, or coaly earth, on account of the predominance of the bitumen.

5. Species. Cinnabar.

This species is also divided into two subspecies, common and fibrous.

Subspecies 1. Common Cinnabar.

Le Cinnabre Commun, Broch. ii. 107. *Dark Red Cinnabar*, Kirw. ii. 223. *Mercure Sulfuré compacte*, Hauy, iii. 440.

Exter. Char.—Found massive or disseminated, or in superficial layers, or cellular and kidney-form, and also crystallized. Forms of the crystals are, a double four-sided pyramid with truncated summits; a cube having its opposite diagonal angles truncated; a rhomboidal prism; a three-sided prism terminated by a three-sided pyramid, which also is truncated. The crystals, which are usually small, are confusedly grouped together: surface of the rhomboidal prism transversely streaked, of the others smooth; external lustre shining or resplendent; internal the same, or only glimmering, vitreous, or adamantine; fracture foliated, uneven, or rarely splintery; fragments sharp-edged.

Colour cochineal red, carmine red, and in some varieties lead-gray; opaque, rarely translucent at the edges; crystals translucent, or semitransparent; streak shining, scarlet red; tender, and easily frangible. Spec. grav. 6.902 to 7.86.

Chem. Char.—Before the blow-pipe common cinnabar is entirely volatilized with a blue flame, and a sulphurous odour.

Constituent Parts.	Lampadius.
Mercury,	81
Sulphur,	15
Iron,	4
	100

Localities, &c.—This is the most common ore of mercury, and may be considered as the gangue or matrix of the other ores. Found not only in primitive mountains, where it forms beds in clay and chlorite slate, but also in stratiform mountains, and even in alluvial rocks. The mines of Almaden in Spain, of Idria in Friouli, and those of the duchy of Deux Ponts, have furnished the greatest quantity of common cinnabar. It is also found in Bohemia, Saxony, and Hungary, and in small quantity in France.

Subspecies 2. Fibrous Cinnabar.

Le Cinnabre d'un Rouge vif, Brochant, ii. 111. *Bright red Cinnabar*, Kirwan, ii. 229. *Mercure sulfuré fibreux*, Hauy, iii. 440.

Exter. Char.—Found massive, disseminated, or superficial,

Metallic Ores.

ficial; lustre glimmering, silky, often also entirely dull: fracture fine grained earthy, or fibrous; fragments blunt-edged.

Colour bright scarlet red, sometimes crimson or aurora red; opaque; streak shining scarlet red; stains; very tender or friable, and very easily frangible.

Localities, &c.—This variety is very rare in a state of purity. According to Hauy, most of the specimens owe their texture to an admixture of radiated sulphuret of iron. It has been found chiefly at Wolfstein in the Palatinate, where it is accompanied by brown iron ore and hematites.

Uses.—Cinnabar is dug out chiefly for the purpose of extracting the metallic mercury. It is employed also as a colouring matter in painting; but the cinnabar used for this purpose is chiefly artificial.

Some other varieties of cinnabar, or sulphuret of mercury, have been noticed by mineralogists, as a native ethiops mineral. This is of a black colour, a loose consistence, and it stains the fingers. It appears to be some bituminous substance penetrated with cinnabar. It is found at Idria.

Alkaline cinnabar of De Born is found at the same place; is of a bright red colour, foliated fracture, with rhomboidal fragments; and supposed to be cinnabar penetrated with an alkaline sulphuret, the odour of which it gives out by friction. Another variety of cinnabar, usually called native vermilion, is in the form of powder. This substance is very rare, but is also sometimes found at Idria.

IV. SILVER Genus.

1. Species. Native Silver.

Id. Kirwan, ii. 108. *Id.* Brochant, ii. 114. *Id.* Hauy, iii. 384.

This is divided into two subspecies, common and auriferous.

Subspecies 1. Common Native Silver.

Exter. Char.—Common native silver is usually found disseminated or superficial, under different imitative forms, as dentiform, filiform, capillary, dendritic, reticulated, veined, or in thin plates; and sometimes crystallized, in cubes, octahedrons, rectangular four-sided prisms, double six-sided pyramids with truncated extremities, double three-sided pyramids with truncated angles, and hollow four-sided pyramids. The crystals are small and grouped together in rows, or dendritical, or reticulated; surface smooth; that of the plates drusy, that of dentiform, filiform, and capillary silver; longitudinally streaked; external lustre glimmering or resplendent; internal always glimmering, metallic; fracture hackly; fragments rather sharp-edged.

Colour silvery white, but sometimes on the surface yellowish brown, or grayish black; opaque; soft; perfectly ductile; flexible, but not elastic; streak shining, metallic. Spec. grav. 10 to 10.47.

Chem. Char.—Native silver is soluble in nitric acid, and may be precipitated by muriatic acid, the muriate of silver being insoluble; or by immersing a plate of copper in the solution of nitrate of silver, the silver is reduced, and appears in the metallic state. Classification.

Localities, &c.—Native silver is not uncommon in most of the mines which furnish the other ores of that metal. The accompanying substances are usually heavy spar, quartz, calcareous spar, fluor spar, pyrites, blende, cobalt, and galena. Native silver is very abundant in Mexico and Peru, and it is also not uncommon in Siberia, in Germany, France, and was lately discovered in the Herland mine in Cornwall.

Subspecies 2. Auriferous Silver.

Exter. Char.—This variety is rarely found massive, but is usually disseminated in small particles, or superficial, or reticulated, or in thin plates; lustre shining or resplendent; fracture hackly.

Colour between silver white and brass yellow, sometimes approaching to gold yellow; it is soft, perfectly ductile; flexible without being elastic, and its specific gravity is greater than common native silver in proportion to the quantity of gold with which it is alloyed.

Constituent Parts.—Auriferous silver is a compound of silver alloyed with gold, the latter sometimes in very considerable proportion.

Localities, &c.—This mineral is very rare. It is found at Konigsberg in Norway, disseminated in massive calcareous spar, fluor spar, and rock crystal, accompanied by blende, galena, and pyrites, in a vein which traverses a rock of slaty hornblende. It is also found in Siberia, in granular heavy spar accompanied by vitreous silver ore, vitreous copper ore, and pyrites.

2. Species. Antimonial Silver Ore.

Argent Antimonial, Brochant, ii. 119. *Id.* Hauy, iii. 391. *Antimoniated Native Silver*, Kirwan, ii. 110.

Essen. Char.—Colour silvery white; brittle.

Exter. Char.—Found massive or disseminated, kidney-form; or crystallized in four-sided oblique prisms, in six-sided prisms, sometimes with the lateral edges truncated, in six-sided tables, and in cubes, having some of the angles truncated. Surface of the crystals longitudinally streaked; lustre weakly shining, or only glimmering; internal lustre shining or resplendent; fracture foliated.

Colour silvery white, sometimes a superficial colour between yellow, black, and gray, or the colour of tempered steel; streak shining; semihard. Spec. grav. 9.44.

Chem. Char.—Before the blow-pipe it is easily reduced; the antimony is driven off and gives out its peculiar odour, while the pure silver remains behind incrusted with a brown slag, which communicates to borax a green colour.

When antimonial silver is dissolved in nitric acid, a whitish crust, which is the oxide of antimony, soon appears on the surface.

This mineral, as its name imports, is an alloy of silver and antimony, in which sometimes a small portion of iron is observed. The proportions of the two metals seem to be very variable.

Constituent

Classification.

Constituent Parts.

	Klaproth.		Vauquelin.
Silver,	76	84	78
Antimony,	24	16	22
	100	100	100

Localities, &c.—This ore of silver is accompanied by calcareous spar, heavy spar, native silver, galena, and quartz, in a vein near the duchy of Furstenburg in Swabia. It has also been found in carbonate of lime and heavy spar near Guadalcanal in Spain.

3. Species. Arsenical Silver Ore.

Id. Kirw. ii. 111. *Argent Antimonial Arsenifere, et ferrifere*, Hauy, iii. 398.

Exter. Char.—Found massive or disseminated, kidney-form or globular, and also crystallized in perfect six-sided prisms; in similar prisms a little flattened, and having the lateral edges rounded; and in acute six-sided pyramids with truncated summits. Lustre weakly shining, sometimes shining; internal lustre shining or resplendent; fracture foliated; fragments sharp-edged.

Colour tin-white, or lead gray, but exposed to the air yellowish, or steel gray; streak shining; soft; brittle.

Chem. Char.—Before the blow-pipe the arsenic is driven off in fumes, diffusing the smell of garlic; there remains behind an impure globule of silver.

Constituent Parts.	Klaproth.
Silver,	12.75
Arsenic,	35.
Iron,	44.25
Antimony,	4.
Loss,	4.
	100.00

Localities, &c.—This is a rare mineral, which has been found at Andreasberg in the Hartz, accompanied by native arsenic, red silver ore, galena, brown blende, and calcareous spar.

4. Species. Corneous Silver Ore.

Id. Kirwan, ii. 113. *La Mine Corné*, Broch. ii. 127. *Argent Muriaté*, Hauy, iii. 418.

Essen. Char.—The colour of horn; fusible like wax.

Exter. Char.—Rarely found massive; sometimes disseminated in globular pieces, often in superficial layers, and very often crystallized. The forms are, the perfect cube, capillary or needle-formed crystals; the crystals are always small, and commonly grouped together. Surface smooth, shining or weakly shining; internal lustre the same; resinous; fracture uneven, or flat conchoidal; fragments blunt edged.

Colour light pearl gray, violet blue, or lead gray; becomes brown or blackish in the air; translucent; sometimes only at the edges; very soft; receives the impression of the nail; ductile, and in thin plates, flexible. Spec. grav. 4.748 to 4.804.

Chem. Char.—Corneous siver ore melts very easily before the blow-pipe, giving out a disagreeable smell, and the globule of silver remains. Metallic Ores.

Constituent Parts.	Klaproth.
Silver,	67.75
Muriatic acid,	21.
Sulphuric acid,	.25
Oxide of iron,	6.
Alumina,	1.75
Lime,	.25
Loss,	3.
	100.00

Localities, &c.—Muriate of silver is always found at the upper part of the vein, and it is said that it sometimes accompanies organized substances. Leaves of native silver have been found attached to petrifactions, at Frankenburg in Hessia; it is supposed that this metallic silver is the result of the decomposition of the muriate of silver. Corneous silver ore is almost always accompanied by vitreous silver, sooty silver, brown iron ore; more rarely by native silver, red silver, galena, quartz, and heavy spar. It is found in Peru and Mexico, in the mines of Freyberg in Saxony, at Allemont in France, and in Siberia.

Another variety of muriate of silver has been described by some mineralogists under the name of earthy corneous silver ore; or, according to the fanciful German name, *butter-milk earth*. This variety has an earthy fracture, owing to a portion of alumina which is combined with it. It is almost friable; the lustre of the streak is resinous, and it feels somewhat greasy.

Chem. Char.—Before the blow-pipe it is slightly agglutinated without melting, and small globules of silver exude from the mass.

Constituent Parts.	Klaproth.
Silver,	25
Muriatic acid,	8
Alumina,	67
With a trace of copper,	—
	100

This variety is found at Andreasberg in the Hartz. Another variety has been described under the name of alkaline silver ore, which is nothing more than the muriate of silver combined with carbonate of lime.

5. Species. Sooty Silver Ore.

Id. Kirw. ii. 117. *L'Argent Noir*, Broch. ii. 132.

Exter. Char.—Found massive or disseminated, perforated or corroded; in superficial layers upon other minerals, or in rounded pieces, covered by muriate of silver; consistence intermediate between solid and friable; dull; fracture fine grained earthy; fragments blunt-edged.

Colour bluish black, or blackish gray; streak shining, metallic; stains a little; easily frangible.

Chem. Char.—Melts easily before the blow-pipe into a slaggy mass, which, by continuing the heat, is partially volatilized, and the globule of silver remains.

Its

Metallic Ores.

Its constituent parts are still unknown; as it is usually accompanied by vitreous, corneous, and some other silver ores, it is supposed to be a mixture of those ores in different proportions.

Localities, &c.—Found in Saxony, in France, and in Hungary.

6. Species. Vitreous Silver Ore.

Sulphurated Silver Ore, Kirw. ii. 115. *L'Argent Vitreux*, Brochant, ii. 134. *Argent Sulphuré*, Hauy, iii. 398.

Exter. Char.—Commonly found massive, disseminated, or superficial; sometimes dentiform, filiform, capillary, dendritic, or reticulated, with other forms and impressions. It is also crystallized in cubes, which are either perfect or truncated on the angles or edges; in octahedrons, which are either perfect, or truncated on the angles; in flat, double, three-sided pyramids, the edges of the one corresponding to the faces of the other; in rectangular four-sided prisms, terminated by a four-sided pyramid; in equiangular six-sided prisms, terminated at the two extremities by a three-sided pyramid; corresponding alternately to three of the lateral edges, forming the garnet dodecahedron, of which all the lateral edges are sometimes slightly truncated; in broad and flat six-sided prisms bevelled at the extremity, and having the angles at the acute lateral edges truncated. The crystals are commonly small, and grouped together in rows, or in knots, like the steps of a stair; the cube and the octahedron are the most common, and the cube is sometimes hollow. The surface of the crystal is usually smooth, sometimes rough or drusy; lustre between shining and weakly glimmering; internal lustre shining, metallic; fracture conchoidal, sometimes foliated; fragments blunt-edged.

Colour dark lead-gray, steel-gray, or blackish gray, varying by exposure to the air; streak shining; soft; ductile; may be cut with a knife; flexible without being elastic. Spec. grav. 6.909 to 7.215.

Chem. Char.—Before the blow-pipe vitreous silver is reduced to the metallic state, and the sulphur is driven off. By gradually heating it in a furnace, the sulphur may be dissipated without fusion, and the silver is reduced to the metallic state in a dendritical or capillary form, exactly resembling native silver.

Constituent Parts.

	Bergman.	Sage.	Klaproth.
Silver	75	84	85
Sulphur,	25	16	15
	100	100	100

Localities, &c.—Vitreous silver is one of the most common silver ores. It is usually accompanied by heavy spar, calcareous spar, and fluor spar; along with the other ores of silver and lead, cobalt and blende. It is found in Bohemia, Saxony, Norway, Siberia, and South America.

7. Species. Brittle Vitreous Silver Ore.

L'Argent Vitreux Aigre, Brochant, ii. 138.

Exter. Char.—Found massive, disseminated, superficial, or crystallized in equiangular six-sided prisms, he terminal faces being sometimes plane, and sometimes convex or concave; the same prism truncated on its terminal edges, or terminated by a six-sided pyramid set on the lateral faces, and having its summit truncated; in equiangular six-sided tables, or in very flat rhomboids. Crystals small, and grouped together; surface smooth, sometimes drusy; prisms longitudinally streaked; lustre shining or resplendent; internal lustre shining, or weakly shining; fracture conchoidal, sometimes uneven; fragments rather sharp-edged.

Classification.

Colour iron-black, or steel or lead gray; soft; brittle. Spec. grav. 7.208.

Chem. Char.—Before the blow-pipe it melts with difficulty; sulphur, antimony, and arsenic, are partially driven off, and there remains a button of metallic silver, which is not very ductile, accompanied by a brown slag.

Constituent Parts.	Klaproth.
Silver,	66.5
Sulphur,	12.
Antimony,	10.
Iron,	5.
Copper and arsenic,	.5
Earthy matters,	1.
Loss,	5.
	100.0

Localities, &c.—This is one of the richest silver ores; and it is usually accompanied by red silver ore, vitreous silver ore, some other metallic ores, and various earthy spars. It is pretty common in Saxony and Hungary, but less abundant than vitreous silver ore. It is also occasionally met with in most other silver mines.

8. Species. Red Silver Ore.

Id. Kirw. ii. 122. *Id.* Broch. ii. 143. *Argent Antimonié Sulphuré*, Hauy, iii. 402.

This is divided into two subspecies; dark red, and bright red silver ore.

Subspecies 1. Dark Red Silver Ore.

Exter. Char.—Found massive or disseminated, superficial, dendritical, or crystallized in equiangular six-sided prisms, which is either terminated by a three-sided pyramid set on the lateral edges, or has its terminal edges truncated, or is terminated by an obtuse six-sided pyramid set on the lateral faces, and having the summit and lateral edges of the pyramid truncated; sometimes the summit of the pyramid is terminated by a second three-sided pyramid, and sometimes the lateral edges of the prism are bevelled. The crystals are small, and variously grouped together, commonly smooth and resplendent, rarely streaked; internal lustre weakly shining, or only glimmering, adamantine, often semimetallic; fracture usually uneven, sometimes conchoidal; fragments rather blunt-edged.

Colour between cochineal red and lead-gray, and sometimes iron black; crystals translucent; in masses opaque; streak but weakly shining, between cochineal red

Classification.

red and crimson red; soft; brittle, and easily frangible. Spec. grav. 5.56 to 5.58.

Chem. Char.—Before the blow-pipe it decrepitates and flies off before becoming red, and then melts with frothing up; part is volatilized and sublimes in the form of a yellowish white powder, and leaves a button of metallic silver.

Its constituent parts are supposed to be nearly the same as the following.

Localities, &c.—Found in almost all silver mines, and is usually accompanied by other silver ores, as well as different metallic ores.

Subspecies 2. Bright Red Silver Ore.

Exter. Char.—Found massive, disseminated, or superficial, and very often crystallized. The forms of its crystals resemble some of those of the former, or are simple six-sided pyramids, or acute six-sided pyramids, having the lateral angles alternately acute and obtuse, with the summit surmounted by a three-sided pyramid placed on the obtuse edges of the first; or surmounted by a six-sided pyramid set on the lateral faces. The crystals are sometimes acicular, and are combined together in a fasciculär or reticulated form. Surface of the crystals sometimes smooth, sometimes drusy; streaked longitudinally, but the pyramids are streaked transversely or obliquely; lustre resplendent or shining; internal lustre shining or weakly shining and adamantine; fracture conchoidal, or fine grained uneven; fragments rather blunt-edged.

Colour blood red, or light cochineal red, sometimes bluish on the surface; crystals semitransparent; in masses translucent, often opaque; streak aurora red; soft, easily frangible. Spec. grav. 5.44 to 5.59.

Chem. Char.—Melts before the blow-pipe; blackens, and burns with a bluish flame, giving out white fumes with the odour of garlic. A button of nearly pure silver remains behind.

Constituent Parts.

	Klaproth.	Vauquelin.
Silver,	62.	56.67
Antimony,	18.5	16.13
Sulphur,	11.	15.07
Sulphuric acid and water,	8.5	–
Oxygen,	–	12.13
	100.0	100.00

The garlic smell, which was formerly supposed to be owing to arsenic, arises from the antimony, which is volatilized by the action of the blow-pipe; although, according to Proust, there are ores of red silver which contain sometimes arsenic and sometimes antimony separately, and sometimes the two metals combined. The red colour of this ore is by Thenard ascribed to the antimony in the state of purple oxide.

Localities, &c.—Red silver ore is usually accompanied by native arsenic, other ores of silver, as well as other metallic ores; and it is found in Bohemia, Saxony, France, Spain, and Hungary.

9. Species. White Silver Ore.

Id. Broch. ii. 150. *Light Gray Silver Ore*, Kirw. ii. 119.

Metallic Ores.

Exter. Char.—Found massive and disseminated; lustre strongly glimmering; fracture even; fragments blunt-edged.

Colour bright lead-gray, or steel-gray; soft; streak shining. Spec. grav. 5.322.

Constituent Parts.—According to some, this mineral is composed of silver, antimony, and sulphur; but according to others, minerals which have been reckoned white silver ores, contain a very considerable proportion of lead, and therefore ought to be arranged among the ores of that metal. Such are the following analyses by Klaproth.

	Light coloured.	Dark coloured.
Silver,	20.40	9.25
Lead,	48.06	41.
Antimony,	7.88	21.5
Iron,	2.25	1.75
Sulphur,	12.25	22.
Alumina,	7.	1.75
Silica,	.25	–
Loss,	1.91	2.25
	100.00	100.00

Localities, &c.—The real white silver ore has been chiefly found in the mine of Himmelfurst, near Freyberg in Saxony, in a gangue of quartz, and accompanied by galena, red silver, and blende.

10. Species. Black Silver Ore.

Exter. Char.—This ore of silver is of a cellular texture; the streak is shining and metallic; it is brittle, and of a black colour; but it can only be known to be a silver ore by obtaining globules of silver under the blow-pipe. It is usually accompanied by vitreous red silver ores. It is supposed that it is some of the other species of silver ores that may have undergone some change from chemical agents. The silver it contains is in very variable proportions.

Localities, &c.—Found in some of the silver mines at Freyberg in Saxony, and Allemont in France. It is common in Peru and Mexico, and it is called by the Spaniards, *negrillo*.

Beside the silver ores already described, other species have been mentioned by mineralogists, the existence of which has not been distinctly ascertained; as the *carbonate* of silver of Widenmann and Kirwan, composed of 72.5 parts of silver, 12 of carbonic acid, and 15.5 of carbonate of antimony and oxide of copper *: the reddish and greenish black silver ore, also described by Kirwan, which is supposed to be a mixture of native and sulphurated silver †. Light lamellar silver ore ‡, composed of alumina, sulphuret of silver, oxide of iron and manganese.

* II. 112.

† *Ibid.* 125.

‡ *Ibid.* 116.

V. COPPER Genus.

1. Species. Native Copper.

Id. Kirw. ii. 128. *Id.* Broch. ii. 158. *Id.* Hauy, iii. 518.

Essen. Char.—Colour reddish yellow, and malleable.

Exter. Char.—Native copper is found massive, disseminated, superficial, or in rounded pieces; also dendritical and capillary, and very often crystallized in perfect

Metallic Ores.

fect cubes, or with truncated edges or angles; double four-sided pyramids; simple and acute three-sided pyramids. Crystals small, and grouped in a dendritical or botryoidal form; lustre shining or weakly shining; internal lustre glimmering or weakly shining; fracture hackly; fragments blunt-edged.

Colour light copper-red, but exposed to the air, yellowish, blackish, or greenish: streak shining; soft, or semihard; ductile, and flexible, but not elastic. Spec. grav. 7.72 to 8.58.

Chem. Char.—Copper immersed for some time in a solution of ammonia, or volatile alkali, changes it to a beautiful blue colour.

Localities, &c.—Native copper is not a very rare mineral; it is found in many copper mines accompanied by the other ores of copper, as in the copper mines of Siberia, Saxony, Hungary, Sweden, and Cornwall in England.

2. Species. Vitreous Copper Ore.

Id. Kirw. ii. 144. *Id.* Broch. ii. 162. *Cuivre Sulfuré*, Hauy, iii. 551.

This is divided into two subspecies; compact and foliated.

Subspecies 1. Compact Vitreous Copper Ore.

Exter. Char.—Found massive or disseminated, sometimes superficial, and rarely crystallized in perfect cubes with convex faces; in perfect octahedrons, or in six sided prisms, terminated by a three-sided pyramid, set on three of the lateral edges. Crystals small; surface smooth and shining; internal lustre strongly glimmering or shining; fracture rhomboidal or even, fragments rather sharp-edged.

Colour lead-gray, iron gray, or yellowish, but sometimes the colour of tempered steel when tarnished; streak shining or resplendent; soft, and easily frangible. Spec. grav. 4.81 to 5.338.

Constituent Parts.	Klaproth.
Copper,	78.5
Sulphur,	18.5
Iron,	2.25
Silica,	.75
	100.00

Subspecies 2. Foliated Vitreous Copper Ore.

Exter. Char.—Always found massive or disseminated, rarely superficial; fracture foliated; fragments blunt edged.

Colour similar to the former, approaching a little more to fawn or yellowish brown.

Constituent Parts.	Klaproth.
Copper,	50
Sulphur,	20
Iron,	25
Loss,	5
	100

Chem. Char.—Vitreous copper ore is often fusible in the flame of a candle, and it melts easily before the blow-pipe, and yields a button of copper enveloped in a blackish slag; heated with borax, gives it a green colour, and digested in a solution of ammonia, changes it to a fine blue.

Vegetation.

Localities, &c.—Vitreous copper ore is accompanied by quartz, calcareous spar, heavy spar, and the other ores of copper; and is common in Siberia, Hungary, Norway, Germany, and Cornwall in England.

3. Species. Variegated Copper Ore.

Purple Copper Ore, Kirwan, ii. 142. *La Mine de Cuivre Panachée*, Brochant, ii. 166. *Cuivre Pyriteux Hepatique*, Hauy, iii. 536.

Exter. Char.—Found massive, disseminated, or superficial, and sometimes, it is said, crystallized in octahedrons; internal lustre shining; fracture conchoidal, or somewhat uneven; fragments rather sharp-edged.

Colour reddish yellow, violet blue, azure blue, and greenish; several colours exist on the same specimen, giving it a variegated appearance, from which it has the name; streak shining; powder reddish; soft, and easily frangible.

Constituent Parts.	Klaproth.	
Copper,	63.7	58
Iron,	12.7	18
Sulphur	19.	19
Oxygen,	4.5	5
Loss,	.1	
	100.0	100

Localities, &c.—Variegated copper ore is accompanied by quartz, calcareous spar, bituminous marly schistus, and other copper ores; and is found in Saxony, Hungary, Sweden, Siberia, and England.

4. Species. Copper Pyrites.

Id. Kirwan, ii. 140. *Id.* Brochant. ii. 169. *Id.* Hauy, iii. 529.

Exter. Char—Found massive, disseminated, sometimes superficial, more rarely in imitative forms, as dendritical, &c. but often crystallized. Forms are, the tetrahedron, which is either perfect, or with its four angles truncated, giving it the appearance of a six-sided table; the perfect octahedron, the summit terminated by a line; a double crystal formed of two tetrahedrons base to base, the angles of the bases being slightly truncated; produce three re-entering angles, and the lateral faces three salient angles. Crystals are small; surface smooth, shining; internal lustre shining or resplendent; fracture often uneven, sometimes conchoidal, fragments rather sharp-edged.

Colour in the fresh fracture, brass yellow, sometimes gold yellow, and steel gray; sometimes with variegated colours; soft or semi-hard; brittle. Spec. grav. 4.08 to 4.3.

Chem. Char.—Before the blow-pipe it decrepitates; gives out a sulphureous odour; fuses into a black globule, and the heat being continued, metallic copper appears. Borax heated with it acquires a green colour.

This

Classification

This ore of copper is composed of sulphur, copper, and iron in variable proportions, and sometimes also a small admixture of gold or silver.

Localities, &c.—This is a very common copper ore. It is equally found in primitive and stratiform mountains, either in veins or in beds, and sometimes in great abundance; in Saxony, Hungary, Sweden, France, and England.

5. Species. White Copper Ore.

Id. Kirwan, ii. 152. *Id.* Brochant, ii. 173.

Exter. Char.—Found massive or disseminated; internal lustre weakly shining; fracture fine grained, uneven; fragments rather sharp-edged.

Colour between silver white and brass yellow; semi-hard; brittle. Spec. grav. 4.5.

Chem. Char.—Before the blow-pipe it gives out a white fume, with the smell of arsenic, and melts into a grayish black slag.

This ore is said to be composed of copper, iron, arsenic, and sulphur.

6. Species. Gray Copper Ore.

Id. Kirwan, ii. 146. *Id.* Brochant, ii. 175. *Id.* Hauy, iii. 537.

Exter. Char.—Found massive or disseminated, superficial, and often crystallized in regular tetrahedrons, which are rare; or having all the edges truncated, or bevelled, sometimes slightly, and sometimes strongly; or having each of its angles surmounted by a three-sided pyramid, set on the lateral faces, with some other modifications. Crystals of various sizes; surface smooth, shining; internal lustre between glimmering and resplendent; fracture uneven, or conchoidal; fragments rather sharp-edged.

Colour steel gray of various shades, lead gray, and the tarnished colours are often variegated; streak black or brown; semi-hard; brittle. Specific gravity 4.44 to 4.86.

Chem. Char.—Before the blow-pipe it decrepitates, and melts into a brittle metallic globule of a grayish colour, giving out a white fume, and communicating to borax a yellowish red colour.

Constituent Parts. Klaproth.

Copper,	16.25	31.36
Sulphur,	10.	11.5
Antimony,	16.	34.09
Silver,	2.25	14.77
Iron,	13.75	3.3
Lead,	34.5	
Silica,	2.5	
Alumina,	–	0.3
Loss,	4.75	4.68
	100.00	100.00

Localities, &c.—This mineral is most frequently found in veins in primitive mountains, accompanied by other ores of copper, as in Germany, France, Sweden, Siberia, and in England.

Metallic Ores.

7. Species. Black Copper Ore.

Id. Kirwan, ii. 143. *Id.* Brochant, ii. 180.

Exter. Char.—Found in the state of powder, with a dull appearance, and little coherence, sometimes incrusting other ores of copper; usually friable; stains; feels meagre.

Colour brownish black, sometimes deep brown.

Chem. Char.—Gives out before the blow pipe a sulphureous smell, and melts with borax into a greenish slag.

It is supposed to arise from the decomposition of vitreous copper ore and copper pyrites, and contains sometimes from 40 to 50 per cent. of copper.

8. Species. Red Copper Ore.

Id. Kirwan, ii. 135. *Id.* Brochant, ii. 181.

This is divided into three subspecies; compact, foliated and capillary.

Subspecies 1. Compact Red Copper Ore.

Exter. Char.—Found massive, disseminated, or superficial; lustre glimmering, semi-metallic; fracture even, or slightly conchoidal; fragments rather sharp-edged.

Colour cochineal red, or lead gray; opaque; streak shining, of a brick red colour; semi-hard, and brittle.

Subspecies 2. Foliated Red Copper Ore.

Exter. Char.—Found massive, disseminated, or superficial, often crystallized in octahedrons, which are either truncated on the angles or edges; in perfect cubes, which are sometimes truncated on the angles, and sometimes on the edges. Crystals small, usually aggregated; surface smooth, shining; internally shining, or weakly shining, between metallic and adamantine; fracture imperfectly foliated; fragments rather sharp-edged.

Colour similar to the former; opaque, translucent at the edges; crystals semi-transparent.

Subspecies 3. Capillary Red Copper Ore.

Fibrous Red Copper Ore, Kirwan, ii. 137. *Le Cuivre Oxidé Rouge Capillaire*, Brochant, ii. 184.

Exter. Char.—Found in small capillary crystals, which are disseminated in small bundles, or sometimes form a superficial incrustation; lustre shining and adamantine.

Colour carmine red, cochineal or scarlet red; crystals translucent.

Chem. Char.—Red copper ore is easily reduced before the blow-pipe without any odour; entirely soluble in muriatic acid without effervescence, but effervesces in nitric acid; by which means it may be distinguished from cinnabar, which is insoluble, and from red silver ore, which dissolves with effervescence.

The constituent parts of red copper ore are supposed to be copper and oxygen, and not a carbonate of copper, as was formerly conjectured.

Localities, &c.—Red copper ore is found in various places accompanying the other ores of the same metal,

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and particularly native copper. The crystallized varieties are rare.

9. Species. Brick-red Copper Ore.

Id. Kirwan, ii. 127. *Id.* Brochant, ii. 187.

Of this also there are two subspecies, earthy and indurated.

Subspecies 1. Earthy Brick-red Copper Ore.

Exter. Char.—Found massive or disseminated, or superficial, in the fissures of other copper ores, composed of fine earthy particles slightly cohering; dull, friable, and staining.

Colour hyacinth red, reddish brown, brownish red, or yellow.

Subspecies 2. Indurated Brick-red Copper Ore.

Exter. Char.—Found massive, disseminated, or superficial; lustre glimmering, or weakly shining; fracture imperfectly conchoidal, even or earthy; fragments rather sharp-edged.

Colour deep hyacinth red, brownish red, or deep brown; streak shining; soft, or semihard; brittle.

Chem. Char.—Before the blow-pipe it is infusible and blackens.

The constituent parts of this ore are supposed to be a mixture of red copper ore, or oxide of copper, and brown oxide of iron, in variable proportions.

Localities, &c.—This ore is usually found accompanying red copper ore.

10. Species. Emerald Copper Ore.

Dioptase, Hauy, iii. 136. *Id.* Brochant, ii. 511.

Essen. Char.—Divisible into an obtuse rhomboid, whose plain angles are 111° and 69°.

Exter. Char.—Found crystallized in six-sided prisms, terminated by a three-sided summit, placed on the three alternate lateral edges; lustre shining, vitreous; fracture foliated; cleavage threefold, parallel to the lateral edges of the summit.

Colour emerald green; translucent, or semi-transparent; semi-hard. Spec. grav. 3.3.

Chem. Char.—Infusible before the blow-pipe, but becomes brown, and tinges the flame of a candle yellowish green.

Constituent Parts.	Vauquelin.
Oxide of copper,	28.57
Silica,	28.57
Carbonate of lime,	42.85
Loss,	.01
	100.00

Localities, &c.—This mineral is found in Siberia, in a matrix covered with malachite.

11. Species. Azure Copper Ore, or *Carbonate of Copper.*

Blue Calciform Copper Ore, Kirwan, ii. 129. *L'Azur de Cuivre*, Brochant, ii. 190. *Cuivre Carbonaté Bleu*, Hauy, iii. 562.

This species is divided into two subspecies, earthy and indurated.

Classification

Subspecies 1. Earthy Azure Copper Ore.

Exter. Char.—Rarely found massive, usually disseminated or superficial; composed of fine particles which are dull and somewhat coherent; fracture earthy.

Colour smalt blue, sometimes sky blue; opaque; stains a little; soft or friable.

Subspecies 2. Indurated or Radiated Azure Copper Ore.

Exter. Char.—Rarely found massive, sometimes disseminated, often superficial, or in imitative forms, as stalactitical, botryoidal, &c. and also crystallized in rectangular four-sided prisms, terminated by four-sided acute pyramids set on the lateral edges; in oblique four-sided prisms, with two broad and two narrow faces, with a four-sided pyramid set on the lateral faces; sometimes the lateral edges are truncated, and the termination is by a six-sided pyramid. Crystals usually small, and variously aggregated; broad faces of the prisms transversely streaked; narrow faces longitudinally; lustre shining or resplendent, vitreous; fracture radiated; fragments blunt-edged, or wedge-shaped.

Colour light azure blue, Prussian or indigo blue; translucent or semi-transparent; streak sky blue; soft; brittle. Spec. grav. 3.4 to 3.608.

Chem. Char.—Soluble with effervescence in nitric acid; nearly infusible before the blow-pipe, but is easily reduced with borax, which assumes a fine green colour.

Constituent Parts.	Pelletier.
Copper,	66
Carbonic acid,	18
Oxygen,	8
Water,	2
Loss,	6
	100

Localities, &c.—This variety of copper ore is not very abundant; but it accompanies the other ores of copper, and other metallic ores, as those of lead, zinc, and iron. It is found in Bohemia, Norway, Siberia, and in the different mines of lead and copper in Britain.

The earthy variety is found in superficial layers on a slaty marl in Hessia, and it is also found superficial on sandstone in Thuringia. Sometimes the whole of the sandstone is impregnated with this earthy carbonate of copper, there called *copper sand earth*, or *copper sandstone*. A similar sandstone, at Gourock near Greenock in Scotland, was a few years ago dug out for the purpose of extracting copper.

12. Species. Malachite.

Id. Kirwan, ii. 131. *Id.* Brochant, ii. 197.

This species is divided into two subspecies, fibrous and compact.

Subspecies

Subspecies 1. Fibrous Malachite.

Cuivre Carbonaté Vert Soyeux. Hauy, iii. 573.

Exter. Char.—Rarely massive, sometimes disseminated, but often superficial, and in the form of small capillary or acicular crystals grouped together in different forms; lustre shining, or when massive glimmering; internal lustre weakly shining, silky; fracture fibrous, straight, or radiated; fragments blunt-edged.

Colour, emerald or apple green; opaque; streak of a lighter colour; soft; brittle.

Subspecies 2. Compact Malachite.

Exter. Char.—Sometimes found massive, disseminated or superficial, but most frequently globular, botryoidal, stalactitical, &c.; surface rough or drusy, sometimes smooth, almost always dull, and rarely shining; internal lustre dull or weakly shining; fracture conchoidal; fragments rather sharp-edged or wedge-shaped.

Colour emerald green, apple green, and blackish green; opaque; soft; brittle. Spec. grav. 3.57 to 3.64.

Chem. Char.—Decrepitates before the blow-pipe, and blackens without fusion; effervesces with acids; colours borax green, and communicates a blue colour to the solution of ammonia.

Constituent Parts. Klaproth.

	Compact Malachite.
Copper,	58
Carbonic acid,	18
Oxygen,	12.5
Water,	11.5
	100.0

Localities, &c.—Both the fibrous and compact malachites are usually found in the same repository, and accompanied with other ores of copper. They are found in Germany, but the finest specimens are brought from Siberia. Scotland affords fibrous malachite in small quantity, as at Leadhills and in Shetland. Malachite is also met with in Cornwall and Derbyshire in England.

Uses.—Malachite, when pure, is sometimes employed as a pigment. The compact variety is susceptible of a fine polish; which, with its beautiful and delicate colours, has brought it into much estimation for various ornamental purposes.

The largest and finest specimen of compact malachite known, is in the cabinet of Dr Guthrie at Petersburgh. It is 32 inches long, 17 broad, and two inches thick. It is estimated, according to the account of Patrin, who describes it, at 20,000 francs, above 800l. sterling. If we are rightly informed, this splendid mass of malachite was once offered to sale in Britain, but, having found no purchaser, was carried back to Russia.

13. Species. Green Copper Ore.

Mountain Green, Kirw. ii. 134. *Id.* Broch. ii. 203.

Exter. Char.—Found massive or disseminated, but usually superficial on other ores; dull; fracture conchoidal or uneven; fragments blunt-edged.

Colour verdigris green, emerald green, sometimes sky blue, opaque, or translucent at the edges; soft, or friable; brittle.

Chem. Char.—Becomes black before the blow-pipe without fusion. Colours borax green.

Constituent Parts.—Supposed to be a mixture of oxide of copper, or according to others, a carbonate, with alumina and lime.

Localities, &c.—It is usually accompanied by gray copper ore, and some other copper ores, particularly with malachite, and sometimes with iron ochre, alumina, and quartz. Found in Saxony, Hungary, and Siberia.

14. Species. Ferruginous Green Copper Ore.

This is divided into two subspecies; 1. earthy; and, 2. slaggy.

Subspecies 1. Earthy Ferruginous Green Copper Ore.

Iron-shot Mountain Green, Kirw. ii. 155. *Id.* Broch. ii. 205.

Exter. Char.—Found massive, but most frequently disseminated; dull, with an earthy fracture; fragments blunt-edged.

Colour light olive green; soft, friable; brittle; meagre to the feel.

Subspecies 2. Slaggy Ferruginous Green Copper Ore.

Glassy Iron-shot Mountain Green, Kirw. ii. 152.

Exter. Char.—Massive, or disseminated; lustre shining, vitreous; fracture conchoidal; fragments sharp-edged.

Colour deep olive green, sometimes black; soft; brittle.

Constituent Parts.—Seems to be a mixture of oxide of copper with iron ochre, in variable proportions.

Localities, &c.—Found along with other copper ores, and is accompanied by iron ochre, heavy spar and quartz. It is a rare mineral. Has been found in Saxony, and it is said in the Hartz.

15. Species. Micaceous Copper Ore, or *Arseniate of Copper.*

Olive Copper Ore, Kirw. ii. 151. *Le Cuivre Arsenical*, Broch. ii. 208. *Cuivre Arseniaté*, Hauy, iii. 575. *Arseniate of Copper*, Bournon, Phil. Trans. 1801. p. 193.

This species is divided into two subspecies, foliated and lenticular.

Subspecies 1. Foliated Micaceous Copper Ore.

Exter. Char.—Found massive, disseminated, or crystallized in oblique four-sided prisms, in six-sided prisms, in acute rhomboids, or in very small cubes. These crystals are also variously modified; lateral faces streaked longitudinally; lustre resplendent, pearly, or adamantine; fracture foliated, sometimes conchoidal.

Colour olive green, sometimes emerald green, or verdigris

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digris green; translucent; crystals semitransparent; soft. Spec. grav. 2.54.

Subspecies 2. Lenticular Micaceous Copper Ore.

Exter. Char.—This variety is found crystallized in octahedrons, composed of two four-sided pyramids, with isosceles triangular faces; crystals small; external lustre shining; fracture foliated.

Colour sky blue, or verdigris green; scratches calcareous spar; brittle; easily frangible. Spec. grav. 2.88.

Chem. Char.—The crystals of these varieties decrepitate before the blow-pipe, and give out the odour of arsenic. They melt into a grayish globule, which being treated with borax, yields a button of copper.

Constituent Parts.	Vauquelin.
Oxide of copper,	39
Arsenic acid,	43
Water,	17
Loss,	1
	100

Localities, &c.—These varieties of copper ores are very rare; and have been hitherto discovered only in the Carrarach mine, Cornwall, accompanied by brown iron ore and other copper ores.

Other arseniates of copper have been described by Bournon. In many respects they resemble the preceding varieties. The spec. grav. which is 4.28, is considerably greater, and yet the proportions of the constituent parts approach very near.

Constituent Parts.	Chenevix.		
	Hæmatitiform.	Capillary.	Foliated.
Oxide of copper,	50	51	54
Arsenic acid,	29	29	30
Water,	21	18	16
Loss,	—	2	—
	100	100	100

Count de Bournon has described another, under the name of cupromartial arseniate, which is also crystallized, has a spec. grav. 3.3, and the following are its constituent parts.

	Chenevix.
Oxide of iron,	27.5
——— copper,	22.5
Arsenic acid,	33.5
Silica,	3.
Water,	12.
Loss,	1.5
	100.0

16. Species. Muriate of Copper, or *Green Sand of Peru.*

Id. Broch. ii. 149. *Id.* Broch. ii. 545.

Char. Exter.—Found massive, or crystallized in very small six-sided prisms, bevelled at the extremities, or in small oblique four-sided prisms, also bevelled at the extremities, but the sides corresponding to the obtuse lateral edges; surface of the crystals smooth and resplendent; lustre adamantine; fracture foliated; fragments rather sharp-edged. Classification.

Colour between emerald and leek green; opaque; crystals a little transparent; soft; streak pale apple green. Spec. grav. 3.57 to 4.43.

Chem. Char.—Thrown on burning coals, it communicates a green colour to the flame; soluble in nitric acid without effervescence.

Constituent Parts.	Proust.		Klaproth.
Oxide of copper,	76.6	70.6	73.
Muriatic acid,	10.6	11.4	10.1
Water,	12.8	18.1	16.9
	100.0	100.0	100.0

Localities, &c.—This mineral has been found in the sand of rivers, accompanied by quartz, schorl, copper and iron ores, near Remolinos in Chili. It has also been found in a similar situation in Peru.

Phosphate of Copper.—This mineral has been found massive, or crystallized in oblique six-sided prisms, with convex faces, lining cavities; lustre resplendent, between vitreous and adamantine; internal lustre silky; fracture fibrous.

Colour grayish black, but internally emerald green; opaque; streak apple green; soft, or semihard.

Constituent Parts.	Klaproth.
Oxide of copper,	68.13
Phosphoric acid,	30.95
Loss,	.92
	100.00

Localities, &c.—This mineral has been found near Bologne, along with malachite, in a white drusy quartz.

Copper Mines.—In addition to the history of copper ores now given, we shall just name some of the more celebrated copper mines in the world. The copper mines of Spain are situated on the frontiers of Portugal, and yield from veins of considerable thickness, yellow pyrites. France possesses copper mines in the Pyrenees, near Lyons, in Vosges, and in the neighbourhood of Savoy, in the department of Mont Blanc. There are extensive copper mines in Piedmont, which have been wrought to a very considerable depth.

The copper mines of Cornwall in England, which are in primitive rocks, have been long celebrated. The most abundant ores are copper pyrites, accompanied by native copper, which latter, it is observed, is most usually found near the surface. The same mines yield all the varieties of arseniate of copper. The Aeton copper mines on the borders of the counties of Derby and Stafford are situated in limestone, in very declining or nearly perpendicular beds; but the richest copper mines in England are those of the island of Anglesea, where is a mass of pyritous copper ore of immense thickness, yielding from 16 to 40 per cent. of copper. Native copper is also found near the surface, and immediately under the turf.

The

Classification. Metallic Ores.

The mines of Cronebane, in the county of Wicklow in Ireland, are very considerable. They are situated in a primitive mountain, composed of flinty slate and argillaceous schistus, which alternate with beds of steatites.

In Germany, Hungary, Sweden, Norway, and Siberia, there are many extensive and valuable copper mines. In the eastern parts of the Asiatic continent, in the island of Japan, in China, and in some of the islands of the Indian ocean, rich copper ores are abundant.

Africa, in various places of that extensive region, abounds with ores of copper, as in the mountains to the north of the Cape of Good Hope. On the western coast of Africa, the natives dig out copper ore, and are acquainted with the mode of extracting it.

In North America masses of native copper have been found, near Hudson's Bay; but the richest copper mines in the world are those of South America, and particularly in Chili, from which masses of native copper of immense magnitude have been obtained. The copper mines of Peru and Mexico are also wrought to great advantage.

VI. IRON Genus.

1. Species. Native Iron.

Id. Kirw. ii. 156. *Id.* Brochant, ii. 215. *Id.* Hauy, iv. 1.

Exter. Char.—Found massive or branched; surface smooth, shining; internal lustre shining, metallic; fracture hackly; fragments rather sharp-edged.

Clour light steel gray, or silvery white; semihard; streak shining; perfectly ductile; flexible; but not elastic.

Localities, &c.—The existence of native iron as a terrestrial production still remains doubtful. It is said that it has been found along with other ores of iron, in Saxony and in France. The only instances fully established of the discovery of native iron, are those of the immense mass found by Pallas in Siberia, which amounted to no less than 1680lb. or 15 cwt. and another of 3 cwt. which was discovered by Rubin de Celis in South America; but these masses correspond so nearly with the substances which are certainly known to have fallen from the atmosphere, in their constituent parts, that it seems extremely probable they have had a similar origin. But for a full account of this curious subject, see Meteorolite.

2. Species. Iron Pyrites.

Martial Pyrites, Kirwan ii. 76. *Id.* Brochant, ii. 221. *Fer sulfuré*, Hauy, iv. 65.

Subspecies 1. Common Iron Pyrites.

Exter. Char.—Found massive or disseminated, superficial, or in imitative forms, and frequently crystallized. The forms are, a perfect cube with plane or convex faces; or with truncated angles, or edges; or having a three-sided pyramid on each angle; the perfect octahedron, or truncated on all its angles; the dodecahedron with pentagonal faces, or with six opposite and parallel edges truncated, or truncated on eight of its angles; or the perfect icosahedron, which is rare.

Crystals small, excepting the cube, and grouped together; surface smooth or streaked; lustre shining, resplendent; internal lustre shining, metallic; fracture uneven; sometimes conchoidal; fragments rather sharp-edged.

Colour bronze yellow, golden yellow, sometimes steel gray; opaque; hard; brittle; rather easily frangible. Spec. grav. 4.6 to 4.83.

Chem. Char.—Before the blow-pipe it gives out a strong sulphureous smell, and burns with a bluish flame; a brownish globule is then obtained, which is attracted by the magnet.

Constituent Parts. Hatchett.

Sulphur,	52.15	52.5
Iron,	47.85	47.5
	100.00	100.0

Some varieties of common iron pyrites contain a mixture of gold, which is supposed to be accidental, as the external characters are not affected by it, and it is only recognized by chemical analysis. These varieties are called auriferous pyrites.

Subspecies 2. Radiated Iron Pyrites.

Exter. Char.—Found massive, or in different imitative forms, and also crystallized in small cubes or octahedrons; surface smooth or drusy; lustre shining or resplendent; fracture radiated; fragments wedge-shaped.

Colour bronze yellow, lighter than the former; sometimes steel gray, and sometimes tarnished; hard; brittle, and easily frangible.

Subspecies 3. Capillary Iron Pyrites.

Exter. Char.—Found in small, capillary, or acicular crystals, having the appearance of flocks of wool; sometimes the crystals are acicular or in a stellated form; lustre shining or weakly shining, metallic.

Colour bronze yellow, approaching to steel gray.

Subspecies 4. Hepatic Iron Pyrites.

Exter. Char.—Massive or disseminated, or in different imitative forms, as stalactitical, cellular, &c.; sometimes crystallized in perfect six-sided prisms or in six-sided tables, which are either perfect or bevelled on the terminal faces. Crystals small; sometimes smooth; sometimes drusy; internal lustre glimmering, or weakly shining; fracture even, or imperfectly conchoidal; fragments sharp-edged.

Colour bronze yellow, steel-gray, sometimes brownish or tarnished; streak shining; hard; brittle.

Physical Char.—By rubbing gives out a sulphureous odour, and, according to some, the smell of arsenic.

Constituent Parts.—According to some mineralogists this variety is composed of sulphur and iron, with a portion of arsenic.

Localities, &c.—The first variety is universally diffused; it is found in every kind of rock, and often in great abundance.

The second is rarer; but is not uncommon in veins of lead and silver, and sometimes in nests in indurated marl. It is found in Saxony and Bohemia, in Derbyshire

Metallic Ores.

shire in England, and at Leadhills and the island of Islay in Scotland.

This variety is more subject than the first to decomposition.

Capillary pyrites is only found in small quantity, as in Saxony, and Andreasberg in the Hartz.

Hepatic pyrites is only found in veins, particularly those of silver and lead, accompanied with quartz, calcareous spar, and heavy spar, as in Germany and Siberia, and at Wanlockhead in Scotland.

Exposed to the air, this variety is extremely liable to decomposition.

3. Species. Magnetic Pyrites.

Id. Kirwan, ii. 79. *Id.* Brochant, ii. 232.

Exter. Char.—Massive or disseminated; internal lustre shining or weakly shining; fracture uneven, rarely conchoidal; fragments rather sharp-edged.

Colour between copper red and bronze yellow; when exposed to the air it becomes brownish or tarnished; hard, or semihard; brittle. Spec. grav. 4.51.

Phys. Char.—This variety of pyrites acts on the magnetic needle, but not very powerfully.

Chem. Char.—Before the blow-pipe it gives out a slight odour of sulphur, and melts easily into a grayish black globule, which is attracted by the magnet.

Constituent Parts. Hatchett.

Iron,	63.5
Sulphur,	36.5
	100.0

Localities, &c.—Magnetic pyrites has been only found in primitive rocks, as in micaceous schistus; and is usually disposed in beds, along with other ores of iron, and accompanied by quartz, hornblende, and garnets. It is found in Saxony, Bavaria, Bohemia, and in Caernarvonshire in Wales.

Uses.—This, as well as the former species, is employed for the purpose of extracting sulphur, or of manufacturing copperas, or sulphate of iron.

4. Species. Magnetic Iron Ore.

Magnetic Ironstone, Kirwan, ii. 158. *Id.* Brochant, ii. 235. *Fer Oxidulé*, Haüy, iv. 10.

This is divided into two subspecies, common and arenaceous.

Subspecies 1. Common Magnetic Iron Ore.

Exter. Char.—Massive or disseminated, and often also crystallized in six-sided prisms, having a three-sided pyramid at each extremity, set on three alternate lateral edges; an oblique four-sided prism; a double four-sided pyramid, or perfect octahedron, which is sometimes truncated on all its edges. Crystals of various sizes; faces sometimes smooth; those of the four-sided prism streaked transversely; lustre shining; internal lustre resplendent, or weakly glimmering; fracture uneven, sometimes conchoidal or foliated; fragments rather blunt-edged.

Colour iron-black, perfect black, or steel-gray; streak brownish black; semihard, or hard; brittle; more or less easily frangible. Spec. grav. 4.2 to 4.93. Classification.

Subspecies 2. Arenaceous Magnetic Iron Ore.

Exter. Char.—Found in rounded grains, from the size of millet to that of a nut, and sometimes in small octahedral crystals; external surface rough or weakly glimmering; internal shining or resplendent; fracture conchoidal; fragments sharp-edged.

Colour deep iron black, sometimes ash-gray.

Phys. Char.—Magnetic iron ore, as the name imports, strongly attracts the magnetic needle, and iron filings; to the compact varieties of this ore, in which this property was first discovered, the name of natural magnet is given.

Chem. Char.—Magnetic iron ore becomes brown before the blow-pipe, and colours borax dark green.

Constituent Parts.—This is supposed to be an oxide of iron in considerable purity, as it yields from 80 to 90 per cent. of metallic iron.

Localities, &c.—Common magnetic iron ore is very common in primitive mountains, particularly in those of gneiss and micaceous schistus, where it forms very powerful beds, and even entire mountains. It is disseminated in crystals in chlorite schistus, as in Corsica, and in basalt and greenstone, at Taberg in Sweden. Found in Saxony, Bohemia, and Italy, and particularly in the island of Elba in the Mediterranean; and indeed is very universally distributed over every part of the globe.

The second variety, or magnetic sand, is found in the beds of rivers, in a loose state, and sometimes imbedded in basalt and wacken. It is found in those countries where the other ores of iron abound; and also in the sand of many of the rivers within the torrid zone, as in Jamaica, St Domingo, &c.

Uses.—Magnetic iron is wrought for the purpose of obtaining metallic iron. Most of the Swedish iron ores belong to this variety, and furnish the iron which is so celebrated on account of its superior qualities, throughout Europe.

Magnetic sand, where it is abundant, is also smelted as an iron ore.

5. Species. Specular Iron Ore.

Id. Broch. ii. 242. *Id.* Kirw. ii. 162. *Micaceous Iron Ore*, ibid. 284. *Fer Oligiste*, Hauy, iv. 38.

This species is divided into two subspecies, common and micaceous.

Subspecies 1. Common Specular Iron Ore.

Exter. Char.—Massive or disseminated, but most frequently crystallized in double three-sided pyramids, flattened, and the lateral faces of the one set on the lateral edges of the other; the same pyramid with the angles at the common base truncated; in perfect cubes, having the angles truncated; or the cube considered as a double three-sided pyramid; or as a rhomboid, in which the summits are surmounted by an obtuse three-sided pyramid, set on the lateral faces; the same cube bevelled at each of the angles of the common base; in six-sided tables variously modified, or in perfect lenses.

Surface

Classification

Surface of the crystals smooth, resplendent; internal lustre weakly shining or resplendent; fracture uneven, sometimes conchoidal or foliated; fragments sharp-edged.

Colour steel-gray, bluish or reddish; sometimes with tarnished colours; which are iridescent; streak dark cherry-red; hard; opaque; brittle. Spec. grav. 4.79 to 5.21.

Chem. Char.—Before the blow-pipe it is infusible; but heated on charcoal becomes white, and melts with borax into a dirty yellow slag.

Phys. Char.—Affects the magnetic needle, but does not attract iron filings.

Constituent Parts.—This variety is supposed to be a pretty pure oxide of iron, yielding from 60 to 80 per cent. of iron.

Of this subspecies two varieties have been formed, compact and foliated, depending probably on the appearance of the fracture.

Subspecies 2. Micaceous Iron Ore.

Exter. Char.—Massive or disseminated, or in thin six-sided tables, so grouped together as to appear cellular; surface smooth, resplendent; internal lustre resplendent; fracture foliated; fragments in tables.

Colour iron-black, steel-gray, or dark red; in thin plates slightly translucent; streak dark cherry-red; semihard; brittle. Spec. grav. 4.5 to 5.

Localities, &c.—These varieties are found in primitive mountains, in beds or veins, accompanied by other ores of iron, and in such quantity in many places as to be dug out for the purpose of manufacture, as in Germany, France, Russia, Sweden, Siberia, and particularly in the islands of Corsica and Elba, which furnish the finest specimens of specular iron ore for the cabinet.

The latter variety is found in England, and some parts of Scotland.

6. Species. Red Iron Ore.

This is divided into four subspecies; 1. red iron froth; 2. compact; 3. red hæmatites; and, 4. red ochre.

Subspecies 1. Red Iron Froth.

Id. Broch. ii. 249. *Red Scaly Iron Ore*, Kirw. ii. 172.

Exter. Char.—Sometimes massive, and frequently superficial; lustre glimmering or shining, usually composed of scaly friable particles which stain strongly; feels greasy.

Colour dark cherry-red, blood-red, brownish-red, or steel-gray.

Chem. Char.—Blackens before the blow-pipe.

Constituent Parts. Hauy.

Iron,	66.
Oxygen,	28.5
Silica,	4.25
Alumina,	1.25
	100.00*

* Nich. Jour. 4to. iii. 456.

Localities, &c.—A rare mineral, usually incrusting other ores of iron. Found in Germany, and in Cornwall and at Ulverstone in Lancashire in England.

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Subspecies 2. Compact Red Iron Ore.

Id. Broch. ii. 251. *Id.* Kirw. ii. 170.

Exter. Char.—Massive or disseminated, in imitative forms, as cellular, &c. or crystallized in perfect cubes, or four-sided pyramids with truncated summits. Surfaces of the cube smooth; that of the pyramids rough and dull; internal lustre glimmering; fracture even, sometimes uneven or conchoidal; fragments rather blunt-edged.

Colour brownish-red, dark steel-gray, sometimes blood-red; semihard; brittle, streak blood-red; stains. Spec. grav. 3.4 to 3.8.

Chem. Char.—Infusible before the blow-pipe.

Constituent Parts. Lampadius.

Oxide of iron,	65.4
Silica,	20.7
Alumina,	9.3
Oxide of manganese,	2.7
Loss,	1.9
	100.0

Localities, &c.—Found along with other iron ores, abundant in Cumberland and Lancashire, and various places of the world.

Subspecies 3. Red Hæmatites.

Id. Kirw. ii. 168. *Id.* Broch. ii. 254.

Exter. Char.—Massive, and in various imitative forms; surface smooth or drusy; internal lustre shining, or only glimmering; fracture fibrous; fragments wedge-shaped.

Colour brownish-red, steel-gray, or blood-red; streak light blood-red; hard or semihard; brittle; stains. Spec. grav. 4.7 to 5.

Constituent Parts.—It yields from 60 to 70 per cent. of iron, and contains, it is supposed, a portion of alumina, silica, and manganese.

Localities, &c.—This ore of iron is not very common although in some places it is very abundant, as in the west of England. It is disposed in veins and beds, accompanied by the former variety.

Subspecies 4. Red Ochre.

Id. Kirw. ii. 171. *Id.* Broch. ii. 256.

Exter. Char.—Found massive, disseminated, or superficial; dull; fracture earthy.

Colour between blood-red and brownish-red; stains much; soft; often friable

Localities, &c.—This variety usually accompanies the former, and is a very fusible iron ore.

7. Species. Brown Iron Ore.

This is divided into four subspecies; 1. brown iron froth; 2. compact; 3. brown hæmatites; and, 4. brown ochre.

Subspecies 1. Brown Iron Froth.

Brown Scaly Iron Ore, Kirw. ii. 166. *Le Fer rouge brun*, Broch. ii. 258.

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Exter. Char.—Massive or disseminated, often superficial, or spumiform; strongly glimmering or shining; fracture foliated or compact.

Colour between brown and dull gray; very soft; almost friable; stains; feels greasy; nearly swims on water.

Chem. Char.—Blackens before the blow-pipe without fusion.

Localities, &c.—Accompanies other iron ores, as in Saxony, but is rare.

Subspecies 2. Compact Brown Iron Ore.

Exter. Char.—Massive or disseminated, sometimes in different imitative forms; dull, or rarely glimmering; fracture smooth, earthy, or conchoidal.

Colour clove brown, or brownish yellow; streak yellowish brown; semihard; brittle. Spec. grav. 3.07 to 3.75.

Localities, &c.—In veins or beds, accompanied by other iron ores, in various parts of the world.

Subspecies 3. Brown Hæmatites.

Id. Kirw. ii. 163. *Id.* Broch. ii. 261.

Exter. Char.—Massive, but most frequently in different imitative forms; surface smooth, granulated, rough or drusy; lustre shining; internal lustre glimmering or weakly shining; fracture fibrous; fragments splintery or wedge-shaped.

Colour clove brown; blackish brown, sometimes yellow, and sometimes with tarnished colours; opaque; streak yellowish brown; semihard; brittle. Spec. grav. 3.78 to 4.02.

Localities, &c.—Always accompanies the preceding variety, but in smaller quantity.

Subspecies 4. Brown Ochre.

Id. Kirw. ii. 167. *Id.* Broch. ii. 263.

Exter. Char.—Massive or disseminated; dull; fracture earthy; fragments blunt-edged.

Colour yellowish brown, or ochre yellow; soft; sometimes friable; stains more or less.

Localities, &c.—Always accompanies compact brown iron ore, and is therefore found in similar places.

8. Species. Sparry Iron Ore.

Id. Brochant, ii. 264. *Id.* Kirw. ii. 190.

Exter. Char.—Massive, disseminated, sometimes with impressions, and often crystallized. Its forms are, the rhomboid with plane or convex faces, or having two opposite angles strongly truncated; and the lens, the equiangular six-sided prism, or the simple or double four-sided pyramid. Crystals small; surface smooth, sometimes drusy, sometimes a little rough; lustre shining and somewhat metallic; internal lustre shining, rarely resplendent, between pearly and vitreous; fracture foliated; fragments rhomboidal.

Colour yellowish gray, grayish white, and exposed to the air, blackish brown, or with tarnished colours; sometimes translucent at the edges; those of a dark colour, opaque; semihard, or soft; brittle. Spec. grav. 3.6 to 4.

Chem. Char.—Before the blow-pipe it blackens without fusion. Classification.

Constituent Parts.—According to Bergman, this mineral contains equal parts of carbonate of lime and of iron, with about one-fourth of manganese.

Localities, &c.—Found equally in primitive and stratiform rocks, and always accompanied by calcareous spar, and other ores of iron, as in Saxony, France, Britain and Ireland.

9. Species. Black Iron Ore.

Id. Kirw. ii. 167. *Id.* Broch. ii. 268.

This species is divided into two subspecies: 1. compact; and 2. black hæmatites.

Subspecies 1. Compact Black Iron Ore.

Exter. Char.—Massive, or in various imitative forms; surface rough or dull; internal lustre glimmering; fracture flat conchoidal; fragments sharp-edged.

Colour between steel gray and bluish-black; semihard; brittle.

Subspecies 2. Black Hæmatites.

Exter. Char.—Massive or kidney-form; internal lustre glimmering and shining; fracture fibrous, sometimes even; fragments wedge-shaped.

Colour steel gray.

Constituent Parts.—This ore is supposed to contain a larger proportion of manganese, with alumina and lime, than other ores of iron.

Localities, &c.—Found in veins in primitive mountains, and sometimes also in stratiform mountains, accompanied by brown and sparry iron ore.

10. Species. Argillaceous Iron Stone.

This is divided into six subspecies: 1. red chalk; 2. columnar argillaceous iron stone; 3. granular; 4. common; 5. reniform; and, 6. pisiform.

Subspecies 1. Red Chalk.

Id. Broch. ii. 271.

Exter. Char.—Massive; fracture slaty; lustre glimmering; cross fracture earthy, dull; fragments in plates, or splintery.

Colour brownish red, black or blood red; streak blood red; writes and stains; soft; adheres to the tongue; feels meagre. Spec. grav. 3.13 to 3.93.

Chem. Char.—Decrepitates, and becomes black when exposed to a red heat.

Localities, &c.—Usually accompanies clay slate, either in thin beds, or in masses, as at Thalitter in Hessia, where it is dug out in considerable quantity. It is also found in Bohemia and Saxony.

Uses.—Employed as crayons in drawing, and for this purpose it is dug out, rather than as an ore of iron.

Red chalk, on account of the quantity of alumina and other earths which it contains, was formerly arranged in the argillaceous genus.

Subspecies

Classification.

Subspecies 2. Columnar Iron Stone.

Id. Kirw. ii. 176. *Id.* Broch. ii. 273.

Exter. Char.—Found in angular or rounded pieces; surface rough and dull; fracture dull and earthy; composed of columnar distinct concretions, which are often a little curved, sometimes straight and articulated, and very easily separated; surface of the concretions rough and dull.

Colour cherry red, blood or brownish red; streak blood red, sometimes yellowish brown; soft; adheres to the tongue; feels meagre, and is a little rough.

Localities, &c.—Usually met with in beds of clay, in stratiform mountains, and particularly in the neighbourhood of subterranean fires, by the effects of which, as it is supposed, it may have been produced. It is found in Bohemia and some other places, where it is wrought as an ore of iron.

Subspecies 3. Granular Iron Stone.

Id. Broch. ii. 274. *Acinose Iron Ore*, Kirw. ii. 177.

Exter. Char.—Massive, or constituting the base of petrifactions; strongly glimmering or weakly shining; fracture uneven, sometimes slaty; fragments blunt-edged.

Colour reddish and yellowish brown, or grayish black; streak blood red, or varying according to the colour of the ore, usually soft or semihard. Specific gravity 2.673.

Constituent Parts.	Lampadius.
Oxide of iron,	64.
Alumina,	23.
Silica,	7·5
Water,	5.
Loss,	·5
	100.0

Localities, &c.—Is found only in stratiform mountains, as in Bohemia, Bavaria, and Switzerland.

Subspecies 4. Common Iron Stone.

Id. Kirw. ii. 173. *Id.* Broch. ii. 276.

Exter. Char.—Massive or disseminated, sometimes cellular or botryoidal; dull; fracture earthy; fragments rather sharp-edged.

Colour yellowish or bluish gray; yellowish brown, or brownish red; streak varies with the colour; soft; brittle; adheres to the tongue; feels meagre.

Localities, &c.—A common ore of iron in many places of Saxony and Bohemia, in Norway, and in England. It is connected with stratiform mountains, alternating with beds of clay slate.

Subspecies 5. Reniform Iron Stone.

Id. Broch. ii. 278. *Nodular Iron Ore*, Kirw. ii. 178.

Exter. Char.—Found in rounded or tuberculated pieces, of a kidney-form figure; surface rough, covered with earthy particles; internal lustre glimmering; fracture smooth or earthy; fragments rather sharp-edged; composed of lamellar and concentric distinct concretions, including a nodule which is usually moveable.

Colour yellowish brown; streak the same; soft; brittle; adheres to the tongue; feels meagre. Specific gravity 2.57.

Metallic Ores.

Localities, &c.—Found in Bohemia, Saxony, Silesia, and Poland, and in the coal countries of England and Scotland, and almost always in clay beds, sometimes accompanied with bituminous wood, in stratiform mountains.

This variety was formerly called *ætites* or *eagle-stone*, as it was supposed that the eagle carried it to its nest.

Subspecies 6. Pisiform Iron Stone.

Id. Kirw. ii. 178. *Id.* Broch. ii. 280.

Exter. Char.—In spherical or flattened particles, which are generally small; surface rough, dull; internal lustre glimmering or weakly shining; fracture smooth.

Colour between brown and red; streak yellowish-brown; semihard; brittle. Spec. grav. 5.2.

Constituent Parts.	Vauquelin.
Iron,	30
Oxygen,	18
Alumina,	31
Silica,	15
Water,	6
	100

Localities, &c.—This variety is found in considerable beds in stratiform mountains. It is abundant in France, Switzerland, and some parts of Germany.

11. Species. Bog Iron Ore.

This is divided into three subspecies: 1. morassy; 2. swampy; and 3. meadow.

Subspecies 1. Morassy Bog Iron Ore.

Id. Kirw. ii. 183. *Id.* Broch. ii. 283.

Exter Char.—Sometimes earthy, sometimes in amorphous, tuberculated, or corroded masses; fracture earthy.

Colour yellowish-brown; stains; soft; friable; feels meagre.

Subspecies 2. Swampy Iron Ore.

Id. Kirw. ii. 138.

Exter. Char.—In amorphous masses, which are tuberose or corroded; dull or slightly glimmering; fracture earthy; fragments blunt-edged.

Colour dark yellowish-brown, blackish brown, or steel-gray; streak light yellowish brown; very soft; brittle; heavier than the former.

Subspecies 3. Meadow Iron Ore.

Id. Kirw. ii. 182. *Id.* Broch. ii. 284.

Exter. Char.—In kidney-form, tuberose, often corroded masses; externally dull or rough; internal lustre shining, resinous; fracture conchoidal, or earthy when it is dull; fragments rather blunt-edged.

Colour dark blackish-brown, or yellowish-brown; streak yellowish-brown; soft and brittle.

Constituent Parts.—Bog iron ore is an oxide of iron, combined with the phosphate of iron, with some earthy matters, as alumina and silica.

Localities, &c.—Bog iron ore is more abundant in the northern than in the southern parts of Europe. It is not uncommon in Poland, Prussia, Sweden, and in the Western islands of Scotland, as Jura and Islay. It is sometimes found in extensive beds, alternating with sandstone and clay.

12. Species. BLUE EARTHY ORE.

Id. Broch. ii. 283. *Blue Martial Earth*, Kirw. ii. 185. *Native Prussiate of Iron*, of others.

Exter. Char.—Usually found slightly cohering, or loose, or friable; particles dull; stains, and feels meagre.

Colour grayish-white, indigo blue, rarely smalt-blue.

Chem. Char.—Becomes reddish-brown before the blow-pipe; melts into a black globule; easily soluble in acids.

Constituent Parts.—It was suspected by Bergman, that this was a native Prusian blue; but according to Klaproth, it is composed of iron and phosphoric acid, with a mixture of alumina.

Localities, &c.—Found in small nests in beds of clay, or bog iron ore, as in Saxony, Russia, and Siberia.

13. Species. GREEN EARTHY IRON ORE.

Green Martial Earth, Kirw. ii. 188.

Exter. Char.—Found friable and superficial, rarely massive; internally dull; fracture earthy.

Colour yellowish or olive-green; stains; soft; feels meagre.

Chem. Char.—Becomes red before the blow-pipe, and then dark-brown, but without fusion.

Constituent Parts.—It is conjectured to be a compound similar to the former, but in different proportions.

Localities, &c.—Found in Saxony, in veins, and accompanied with quartz and pyrites.

14. Species. PHOSPHATE OF IRON.

Id. Jour. de Physique, lviii. 259. Ann. de Chim. l. 200.

Exter. Char.—Found in rounded pieces, composed of capillary crystals, which seem to be four-sided prisms; fracture radiated and divergent.

Colour blue, from a blue powder coating the crystals, which are otherwise colourless; semitransparent. Spec. grav. 2.5 to 2.6.

Constituent Parts.

	Cadet.	Laugier.
Oxide of iron,	42.1	41.25
Phosphoric acid,	26.9	19.25
Silica,	3.	1.25
Alumina,	5.8	5.
Lime,	9.1	—
Water,	13.1	31.25
Loss,	—	2.
	100.0	100.00

Localities, &c.—This mineral is found imbedded in clay in the isle of France, and in Brazil.

15. Species. PITCHY IRON ORE, or *Phosphate of Iron and Manganese.*

Id. Broch. ii. 533. Jour. de Mines, N° 64. p. 295.

Exter. Char.—Massive; surface earthy and dull; internal lustre weakly shining, resinous; fracture compact or foliated.

Colour dark reddish-brown, or black; opaque; semihard; brittle; streak dark red. Spec. grav. 3.956.

Chem. Char.—Melts before the blow-pipe into a black enamel.

Constituent Parts.	Vauquelin.
Oxide of iron,	31
Oxide of manganese,	42
Phosphoric acid,	27
	100

Localities, &c.—Found near Limoges.

16. Species. CUBE ORE, or *Arseniate of Iron.*

Id. Phil. Trans. 1801. p. 190.

Exter. Char.—Found crystallized in small cubes, grouped together in a drusy form; crystals sometimes truncated on their angles; surface smooth, shining; lustre between resinous and adamantine; fracture conchoidal.

Colour olive-green, yellow, or brown; translucent; semihard; powder yellow. Spec. grav. 3.

Chem. Char.—Before the blow-pipe froths up with the smell of arsenic, and melts into a yellowish-gray metallic globule.

Constituent Parts.

	Vauquelin,	Chenevix.
Oxide of iron,	48	45.5
Oxide of copper,	—	9.
Arsenic acid,	18	31.
Silica,	—	4.
Lime,	2	—
Water,	32	10.5
	100	100.0

Localities, &c.—Found in the copper mines in Cornwall.

17. Species. ARSENIATE OF IRON AND COPPER.

Id. Phil. Trans. 1801. p. 219.

Exter. Char.—Crystallized in four-sided rhomboidal prisms, with two edges very obtuse, and two very acute, terminated by an acute four-sided pyramid; edges of the prism are sometimes truncated.

Colour bluish-white; crystals semitransparent; semihard. Spec. grav. 3.4.

Constituent Parts.

Oxide of iron,	27.5
Oxide of copper,	22.5
Arsenic acid,	33.5
Silica,	3.
Water,	12.
Loss,	1.5
	100.0

Classification

Localities, &c.—Found in Cornwall, in Siberia, and Spain.

18. Species. Chromate of Iron.

Id. Broch. ii. 534. *Id.* Hauy, iv. 129.

Exter. Char.—Massive; glimmering or weakly shining; fracture compact and uneven, or imperfectly foliated.

Colour grayish or blackish brown; opaque; streak ash-gray; smell earthy when breathed on; hard. Spec. grav. 4.032.

Chem. Char.—Infusible before the blow-pipe; melts with borax, and colours it of a beautiful green.

Constituent Parts.

Oxide of iron,	35
Chromic acid,	43
Alumina,	20
Silica,	2
	100

Localities, &c.—Discovered by Pontier in France, in the department of Var, and found in considerable abundance in veins and nodules, in beds of serpentine; found also in Siberia.

VII. LEAD Genus.

1. Species. Galena.

This is divided into two subspecies; common and compact galena.

Subspecies 1. Common Galena.

Id. Kirw. ii. 216. *Id.* Broch. ii. 294. *Plomb Sulfuré*, Hauy, iii. 456.

Exter. Char.—Massive, disseminated, superficial, in imitative forms, or crystallized in cubes, octahedrons, six-sided prisms, and six-sided tables, all which are variously modified by truncations and bevelments on the edges and angles. Crystals grouped or imbedded; surface smooth, or drusy; lustre from glimmering to resplendent; internal the same; fracture foliated; fragments cubic, excepting the fine-grained galena.

Colour lead-gray, sometimes tarnished, or irideseent; soft; easily frangible; stains a little. Spec. grav. 7.22 to 7.58.

Chem. Char.—Decrepitates before the blow-pipe, and fuses, giving out a sulphureous odour.

Constituent Parts.—Composed of sulphur and lead in variable proportions, and generally a little silver, sometimes antimony. The proportion of lead is from 50 to 80 per cent.

Localities, &c.—This is the most common ore of lead, and exists in all kinds of rocks, either in beds or veins. In many countries this lead ore is dug out to a great extent, as in Germany, France, and Britain.

Subspecies 2. Compact Galena.

Id. Kirw. ii. 218. *Id.* Broch. ii. 301.

Exter. Char.—Massive, disseminated, kidney-form, or specular; lustre of the specular variety resplendent; the others only glimmering; internal lustre glimmering; fracture even or conchoidal; fragments rather sharp-edged. Metallic Ores.

Colour lead or steel gray; streak shining; stains; soft. Spec. grav. 7.44.

Localities, &c.—This is a rare mineral. It is found along with common galena, in Saxony, and other parts of Germany; in Derbyshire, where it is known by the name of *slickenside*, and in the county of Durham, where it is known by the name of *looking-glass ore*.

2. Species. Blue Lead Ore.

Id. Kirw. ii. 220. *Id.* Broch. ii. 203.

Exter. Char.—Rarely massive, most commonly crystallized in regular six-sided prisms, which are often a little curved, and sometimes fascicularly grouped; surface rough; longitudinally streaked; lustre glimmering; fracture even.

Colour between lead-gray and indigo blue; opaque; streak shining; soft, easily frangible. Specific gravity 5.46.

Chem. Char.—Melts easily before the blow-pipe; burns with a bluish flame, and a sulphureous odour, leaving a globule of lead.

Its constituent parts have not been exactly ascertained. Supposed to be a green lead ore, which has undergone some change, but retaining its original form.

Localities, &c.—This ore has only been found in Saxony, and also, it is said, in France and Hungary.

3. Species. Brown Lead Ore.

Id. Kirw. ii. 222. *Id.* Broch. ii. 305.

Exter. Char.—Rarely massive, commonly crystallized in equal six-sided prisms, or the crystals are acicular or capillary; lustre glimmering; internal shining; fracture uneven.

Colour reddish or clove-brown; translucent at the edges; streak white; soft; brittle. Spec. grav. 6.6 to 6.97.

Chem. Char.—No effervescence with acids; fuses readily before the blow-pipe, but is not reduced; crystallizes in small needles on cooling.

Constituent Parts.	Klaproth.
Oxide of lead,	78.58
Phosphoric acid,	19.73
Muriatic acid,	1.65
Loss.	.04
	100.00

Localities, &c.—Found along with white lead ore, quartz, and heavy spar, in France and Germany.

4. Species. Black Lead Ore.

Id. Kirw. ii. 221. *Id.* Broch. ii. 307.

Exter. Char.—Massive, disseminated, cellular, but most frequently crystallized in six-sided prisms, with equal or unequal sides, or bevelled at the extremity. Crystals small, irregularly grouped; smooth, and sometimes longitudinally streaked; lustre shining; fracture uneven.

Colour

Metallic Ores.

Colour grayish black; opaque; streak grayish black; soft; brittle. Spec. grav. 5.7.

Chem. Char.—Decrepitates before the blow-pipe; and is then reduced to the metallic state.

Constituent Parts.	Lampadius.
Oxide of lead,	78.5
Carbonic acid,	18.
Carbone,	1.5
Water,	2.
	100.0

Localities, &c—Found in Saxony, England, and Scotland, frequently accompanying white lead ore.

5. Species. WHITE LEAD ORE, or *Carbonate of Lead.*

Id. Kirw. ii. 203. *Id.* Broch. ii. 309. *Plomb Carbonaté*, Hauy, iii. 475.

Exter. Char.—Rarely massive, commonly disseminated, superficial, or crystallized in six-sided prisms; in four-sided prisms; in double crystals, composed of two four-sided prisms; in oblique four-sided prisms, and in double six-sided praymids. These are variously modified by truncations and acuminations on the edges and angles. They are also of various sizes, and variously grouped together: surface usually smooth, resplendent, sometimes rough or streaked; lustre shining, adamantine; fragments conchoidal, splintery, or fibrous.

Colour white, yellowish, or grayish white; transparent or translucent; refraction double. Specific gravity 6.48 to 7.23.

Chem. Char.—Decrepitates before the blow-pipe, becomes yellowish or reddish, and melts into a metallic globule; effervesces strongly with acids.

Constituent Parts.

	Klaproth.	Macquart.
Oxide of lead,	82	73
Carbonic acid,	16	24
Water,	2	3
	100	100

Some carbonates of lead are also combined with a small portion of iron and earthy matters.

Localities, &c.—Found in veins, accompanied by galena and other lead ores, in Germany, France, and Britain.

6. Species. GREEN LEAD ORE, or *Phosphate of Lead.*

Plomb Phosphaté, Hauy, iii. 490. *Id.* Broch. ii. 314. *Phosphorated Lead Ore*, Kirw. ii. 207.

Exter. Char.—Massive or disseminated, botryoidal or reniform, and often crystallized in six-sided prisms, truncated on all the edges, or on the terminal edges, or terminated by a six-sided pyramid; in six-sided prisms with the lateral faces converging towards one of the extremities; and in six-sided pyramids; but this last is rare. Surface smooth, shining; internal lustre weakly shining and resinous; fracture uneven.

Colour olive green, emerald green, yellow or brown; grayish, greenish, or yellowish white; translucent, or only at the edges; streak greenish white; brittle. Spec. grav. 6.909 to 6.941.

Classification.

Chem. Char.—Melts easily before the blow-pipe, into a grayish polyhedral globule, but without being reduced; soluble in acids, without effervescence, but sometimes with difficulty.

Constituent Parts.	Klaproth.	
Oxide of lead,	77.10	80.
Phosphoric acid,	19.	18.
Muriatic acid,	1.54	1.62
Oxide of iron,	.10	–
Loss,	2.26	.38
	100.00	100.00

Localities, &c.—Found in veins, along with other lead ores, and generally near the top of the vein, in Germany, France, and Leadhills in Scotland.

7. Species. RED LEAD ORE, or *Chromate of Lead.*

Id. Broch. ii. 318. *Red Lead Spar*, Kirw. ii. 214.

Exter. Char.—Rarely massive, sometimes disseminated or superficial, but most frequently crystallized in oblique four-sided prisms with the extremity bevelled, or the lateral edges truncated; and in six-sided prisms, with two broad and two narrow faces; lateral faces longitudinally streaked; external surface smooth, shining; fracture even.

Colour aurora red, or hyacinth red; translucent or semitransparent; streak orange yellow; soft; brittle. Spec. grav. 5.75 to 6.02.

Chem. Char.—No effervescence with acids; decrepitates a little before the blow-pipe, and melts into a black slag.

Constituent Parts.	Vauquelin.
Oxide of lead,	64
Chromic acid,	36
	100

Localities, &c.—Found in veins at Beresof in Siberia, accompanied by other ores of lead, some ores of iron, and native gold.

A similar ore of lead, but of a brown colour, was brought from Mexico by Humboldt.

8. Species. YELLOW LEAD ORE, or *Molybdate of Lead.*

Id. Broch. ii. 322. *Yellow Lead Spar*, Kirw. ii. 212. Hauy, iii. 498.

Exter. Char.—Rarely massive, usually crystallized in rectangular four-sided tables; in perfect cubes, with plane or convex faces, or truncated on the terminal faces, in obtuse octahedrons, truncated on the summit, the lateral angles, or lateral edges. Crystals small; surface smooth and shining; internally shining; lustre waxy; fracture conchoidal.

Colour wax yellow, or honey yellow; translucent, or only at the edges; soft; brittle. Spec. grav. 5.48 to 5.7

Chem.

Classification. Metallic Ores.

Chem. Char.—Before the blow-pipe it decrepitates strongly, and then melts into a blackish-gray globule, in which are seen particles of lead. Soluble in nitric acid, and in fixed alkalies.

Constituent Parts.

	Macquart.	Hatchett.
Oxide of lead,	63.5	58.4
Molybdic acid,	28.	38.
Oxide of iron,	—	2.1
Silica,	4.	.28
Carbonate of lime,	4.5	—
Loss,	—	1.22
	100.0	100.00

Localities, &c.—This ore of lead was first discovered at Bleyberg in Carinthia; it has been since found in Saxony and France.

9. Species. Native Sulphate of Lead.

Id. Kirw. ii. 211. Broch. ii. 325. Hauy, iii. 503.

Exter. Char.—Crystallized in irregular octahedrons, which are variously truncated and bevelled. Crystals smooth and shining; lustre shining and vitreous; fracture compact.

Colour snow white, grayish or yellowish white; translucent; semihard. Spec. grav. 6.3.

Chem. Char.—Reduced even in the flame of a candle; insoluble in nitric acid.

Constituent Parts.	Klaproth.
Oxide of lead,	70.5
Sulphuric acid,	25.75
Water,	2.25
Loss,	1.5
	100.00

Localities, &c.—Found on brown iron ore in the island of Anglesea, and on galena in the veins at Leadhills and Wanlockhead in Scotland.

10. Species. Earthy Lead Ore.

Id. Broch. ii. 327. *Id.* Kirwan, ii. 105.

This is divided into two subspecies: 1. friable; and, 2. indurated.

Subspecies 1. Friable Lead Ore.

Exter. Char.—This is composed of fine earthy particles, which are dull, and have little coherence.

Colour sulphur or ochre yellow, yellowish or smoke gray; stains; feels meagre.

Subspecies 2. Indurated Lead Ore.

Exter. Char.—Massive or disseminated; dull; fracture uneven or earthy.

Colour of the former; opaque; streak lighter colour; very soft and friable.

Chem. Char.—Easily reduced before the blow-pipe, into a black slag; effervesces a little with acids.

Constituent Parts.—Earthy lead ore is supposed to be a mixture of oxide of lead, with a little oxide of iron, and some earthy matters.

Localities, &c.—Found on the surface, or in the cavities of other lead ores, in Saxony, France, Siberia, and at Leadhills and Wanlockhead in Scotland.

11. Species. Muriate of Lead.

Exter. Char.—Massive, or crystallized in cubes, or flat six-sided prisms; external surface shining; internal lustre resplendent, adamantine; fracture foliated.

Colour between asparagus green and wine yellow; semitransparent; soft; not brittle; streak dull, white.

Constituent Parts.	Klaproth.
Oxide of lead,	55
Muriatic acid,	45
	100

Localities, &c.—Found in Derbyshire, and also, it is said, in the mountains of Bavaria, but not crystallized.

12. Species. Murio-Carbonate of Lead.

Id. Bournon and Chenevix, Nich. Jour. 4to. p. 219.

Exter. Char.—Crystallized in cubes, which are variously modified; lustre shining, adamantine; fracture foliated; cross fracture conchoidal.

Colour straw yellow, or clear white; semitransparent; streak dull; snow white; easily scratched by carbonate of lead. Spec. grav. 6.065.

Constituent Parts.	Chenevix.	
Oxide of lead,	51	Muriate of lead, 59
Muriatic acid,	8	
Oxide of lead,	34	Carbonate of lead, 40
Carbonic acid,	6	
Loss,	1	1
	100	100

Localities, &c.—Found in Derbyshire.

13. Species. Arseniate of Lead.

Id. Broch. ii. 546.

Exter. Char.—Disseminated sometimes in an earthy state, sometimes in silky filaments, and crystallized in small, double, six-sided pyramids. Dull, or weakly glimmering; lustre silky.

Colour citron or greenish yellow; very soft; friable.

Chem. Char.—Before the blow-pipe is melts easily into a globule of lead, and gives out the smell of garlic.

Const. Parts.—Composed of oxide of lead and of arsenic, with some oxide of iron and earthy matters.

VIII. TIN Genus.

1. Species. Tin Pyrites.

Id. Kirw. ii. 200. *Id.* Broch. ii. 332.

Exter. Char.—Found massive or disseminated; lustre shining

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shining or weakly shining; fracture uneven; fragments rather blunt-edged.

Colour steel gray, sometimes brass or bronze yellow; semihard; brittle. Spec. grav. 4.3 to 4.7.

Chem. Char.—Before the blow-pipe it melts easily into a black slag, but without being reduced, and gives out a sulphureous smell.

Constituent Parts.	Klaproth.
Tin,	34
Copper,	36
Iron,	3
Sulphur,	25
Earthy substances,	2
	100

Localities, &c.—This is a rare mineral, found only in Cornwall, in a vein along with copper pyrites.

2. Species. Common Tinstone, or *Oxide of Tin.*

Id. Kirw. ii. 197. *Id.* Broch. ii. 334. Hauy, iv. 137.

Exter. Char.—Massive, disseminated, in rounded pieces or grains, and often crystallized in rectangular four-sided prisms, which are variously modified by truncations and bevelments; in octahedrons, which are rare; in eight-sided prisms, or in double octahedrons, which are so united by one of their summits as to form a re-entering angle. Crystals of various sizes, always grouped together; surface smooth; lustre shining or resplendent; internal lustre shining, between vitreous and resinous; fracture uneven.

Colour brownish black, blackish brown, yellowish gray, or grayish white; opaque, or semitransparent; streak light gray; hard; brittle. Specific gravity 6.3 to 6.9.

Chem. Char.—Before the blow-pipe it decrepitates, loses its colour, and is partially reduced to the metallic state.

Constituent Parts.	Klaproth.
Tin,	77·5
Iron,	.25
Oxygen,	21.5
Silica,	.75
	100.00

Localities, &c.—Found in Germany, in the East Indies, and particularly in Cornwall in England. It is not very universally distributed; but where it exists, it is deposited in granite, gneiss, micaceous schistus, and porphyry; and either in masses, veins, or disseminated in the rocks.

3. Species. Grained Tin Ore, or *Wood Tin.*

Id. Broch. ii. 340. *Id.* Kirw. ii. 298.

Exter. Char.—Found only in small pieces, rounded or angular; surface rough; weakly shining; internal lustre glimmering; a little silky; fracture fibrous; fragments wedge-shaped.

Colour hair brown of various shades; streak yellowish gray; hard and brittle. Spec. grav. 5.8 to 6.4.

Chem. Char.—Becomes brownish red before the blow-pipe, then decrepitates strongly, but is infusible. Classification.

Const. Parts—According to Klaproth, it is composed of 63 of tin in the 100, with a little iron and arsenic.

Localities, &c.—Found in Cornwall, in alluvial land, where it seems to have been deposited in a stalactitical form, accompanied by common tin.

IX. Bismuth Genus.

1. Species. Native Bismuth.

Id. Kirw. ii. 264. *Id.* Broch. ii. 343. *Id.* Hauy, iv. 184.

Exter. Char.—Rarely massive, but usually disseminated in a plumose or reticulated form, and rarely crystallized, in small four-sided tables or cubes; lustre shining or resplendent; fracture foliated.

Colour silvery white, inclining to red; colours commonly tarnished; soft; almost ductile. Specific gravity 9.02 to 9.82.

Chem. Char.—Fusible almost in the flame of a candle; by increasing the heat it is volatilized; soluble with effervescence in nitric acid, and precipitated by water in the form of a white powder.

Localities, &c.—Bismuth is a rare metal, found in veins in primitive mountains, accompanied by calcareous spar, heavy spar, and quartz, and commonly with gray cobalt, sometimes also with black blende and native silver. Found in Saxony, Bohemia, France, and Sweden.

2. Species. Vitreous Bismuth Ore.

Sulphurated Bismuth, Kirwan, ii. 266. *Id.* Brochant, ii. 346.

Exter. Char.—Massive or disseminated, rarely crystallized in small imbedded capillary prisms; lustre shining or resplendent; fracture radiated or foliated.

Colour between lead gray and tin white; stains a little; soft; easily frangible. Specific gravity 6.13 to 6.46.

Chem. Char.—Easily fusible before the blow-pipe, with a sulphureous odour.

Const. Parts.—Composed of bismuth about 60 per cent. and sulphur with a little iron.

Localities, &c.—Found in Bohemia, Saxony, and Sweden, and is usually accompanied by native bismuth.

3. Species. Ochre of Bismuth.

Id. Kirwan, ii. 265. *Id.* Brochant, ii. 348.

Exter. Char.—Rarely massive, commonly disseminated on the surface of other minerals; internally glimmering; fracture uneven or earthy.

Colour yellowish gray, ash gray, or straw yellow, opaque; soft; sometimes even friable. Spec. grav. 4.37.

Chem. Char.—Very easily reduced before the blow-pipe to the metallic state; effervesces with acids.

Constituent

Classification.

Constituent Parts.	Lampadius.
Oxide of bismuth,	86.3
——— iron,	5.2
Carbonic acid,	4.1
Water,	3.4
Loss,	1
	100.0

Localities, &c.—This mineral is very rare, and chiefly found near Schneeberg in Saxony, along with native bismuth; and also in Bohemia and Suabia.

X. ZINC Genus.

1. Species. Blende.

Id. Brochant, ii. 350. *Id.* Kirwan, ii. 237. *Zinc Sulfuré*, Hauy, iv. 167.

This species is divided into three subspecies; yellow, brown, and black.

Subspecies 1. Yellow Blende.

Exter. Char.—Massive or disseminated, or sometimes crystallized in cubes or octahedrons, but they are so confused as to prevent the form being easily discovered. Surface smooth, resplendent; internal lustre resplendent, between adamantine and vitreous; fracture foliated; cleavage six-fold; fragments rather sharp-edged, or assume sometimes a dodecahedral form, which is the result of the complete cleavage.

Colour dark sulphur yellow, olive green, or brownish red; translucent, sometimes semitransparent; streak yellowish gray; semi-hard; brittle. Spec. grav. 4.04 to 4.16.

Chem. Char.—Decrepitates before the blow-pipe, and becomes gray, but is infusible.

Constituent Parts.	Bergman.
Zinc,	64
Sulphur,	20
Iron,	5
Fluoric acid,	4
Water,	6
Silica,	1
	100

Physical Char.—Most of the varieties of yellow blende become phosphorescent by friction in the dark.

Localities, &c.—Found in Saxony, Bohemia, Hungary and Norway, accompanied by lead, copper, and iron ores. It is rather a rare mineral.

Subspecies 2. Brown Blende.

Exter. Char.—Massive, disseminated, and sometimes crystallized in simple three-sided pyramids, octahedrons, and four-sided prisms, which are variously modified. External lustre shining or resplendent; surface sometimes drusy; internal lustre shining, between vitreous and resinous; fracture foliated; cleavage six-fold.

Colour reddish, or yellowish brown; colour sometimes tarnished; translucent, or opaque; crystals transparent; streak yellowish gray; semi-hard; brittle. Spec. grav. 4. Metallic Ores.

Constituent Parts.	Bergman.
Zinc,	44
Sulphur,	17
Iron,	5
Silica,	24
Alumina,	5
Water,	5
	100

Localities, &c.—Very common in veins of lead ore, in most parts of the world.

Subspecies 3. Black Blende.

Exter. Char.—Massive, or disseminated, or crystallized like the former, which it resembles in most of its characters.

Colour perfect black, brownish black, or blood red; often iridescent.

Constituent Parts.	Bergman.
Zinc,	45
Sulphur,	29
Iron,	9
Lead,	6
Silica,	4
Water,	6
Arsenic,	1
	100

Localities, &c.—Found in the same places with the former.

2. Species. Calamine.

This is divided into two subspecies, compact and foliated.

Subspecies 1. Compact Calamine.

Id. Kirwan, ii. 234. *Id.* Brochant, ii. 361.

Exter. Char.—Massive or disseminated, cellular, or stalactitical; dull; fracture compact or earthy.

Colour grayish white, yellowish, or reddish, or milk white; opaque; semi-hard or friable; brittle; stains sometimes. Spec. grav. 3.52, to 4.1.

Chem. Char.—Decrepitates before the blow-pipe when suddenly heated; is infusible. Forms a jelly with acids, and sometimes effervesces.

Constituent Parts.

	Bergman.	Tennant.
Oxide of zinc,	84	68.3
Silica,	12	25
Iron,	3	–
Alumina,	1	–
Water,	–	4.4
Loss,	–	2.3
	100	100.0

Metallic Ores.

	Tennant.	
Oxide of zinc,	64.8	65.2
Carbonic acid,	35.2	34.8
	100.0	100.0

Another variety examined by the same chemist contained,

Oxide of zinc,	71.4
Carbonic acid,	13.5
Water,	15.1
	100.0

From these analyses it appears, that calamines are very different in their composition, consisting sometimes of oxide of zinc, silica, and water, and this variety forms a jelly with acids; others are composed of carbonic acid and oxide of zinc, which effervesce in sulphuric acid, but do not form a jelly; a third variety is composed of oxide of zinc, carbonic acid, and water, constituting a hydro-carbonate of zinc, which is soluble with effervescence in sulphuric acid.

Localities, &c.—Usually accompanied with iron ochre, and very often with galena, white lead, and other metallic ores. Found in Bohemia, Bavaria, France, and Britain, in some places in considerable abundance.

Subspecies 2. Foliated Calamine.

Id. Brochant, ii. 364. Kirwan, ii. 236. Hauy, iv. 161.

Exter. Char.—Found massive or disseminated, stalactitical, incrusted, or crystallized, in small four-sided tables, or in very small cubes with plane or convex faces, shining, or glimmering; lustre between pearly and vitreous; fracture radiated.

Colour yellowish, or smoke gray; grayish, or yellowish white; translucent or semitransparent; semihard; brittle. Specific gravity 3.52.

Chem. Char.—Becomes white before the blow-pipe, but is infusible, and does not effervesce with acids.

Phys. Char.—Becomes electric by heat.

Localities, &c.—This variety accompanies the former, lining its cavities, but is less common. It is found in the same places.

XI. ANTIMONY Genus.

1. Species. Native Antimony.

Id. Brochant, ii. 369. *Id.* Kirwan, ii. 245. *Id.* Hauy, iv. 252.

Exter. Char.—Found massive, disseminated, or reniform; resplendent; fracture foliated.

Colour tin white; but exposed to the air, grayish or yellowish; soft; easily frangible. Spec. grav. 6.7.

Chem. Char.—Before the blow-pipe it is very easily fusible into a metallic globule, which gives out fumes with the odour of garlic.

Const. Parts.—Native antimony sometimes contains a small proportion of arsenic.

Localities, &c.—Has only been found in two places: at Sahlberg in Sweden, where it was discovered in 1748, in limestone; and at Allemont in France, where it is accompanied by other ores of antimony and cobalt.

Classification.

2. Species. Gray Ore of Antimony.

Id. Brochant, ii. 371. Kirwan, ii. 246. Hauy, iv. 64.

This is divided into four subspecies; compact, foliated, radiated, and plumose.

Subspecies 1. Compact Gray Ore of Antimony.

Exter. Char.—Massive or disseminated; shining; fracture uneven.

Colour lead gray, or steel gray; soft; not very brittle; stains a little; streak shining. Spec. grav. 4.36.

Localities, &c.—This variety is rarer than the others, but is met with in Saxony, Hungary, and France.

Subspecies 2. Foliated Ore of Antimony.

Exter. Char.—Massive or disseminated; fracture foliated. In other characters it resembles the other varieties, and is usually accompanied by the following.

Subspecies 3. Radiated Ore of Antimony.

Exter. Char.—Massive, disseminated, and very often crystallized in acicular, often in capillary crystals, and in six and four-sided prisms variously modified; surface streaked longitudinally; internal lustre resplendent; fracture radiated, straight, parallel, or divergent.

Colour similar to the preceding; soft; not very brittle. Spec. grav. 4.1 to 4.5.

Constituent Parts.	Bergman.
Antimony,	74
Sulphur,	26
	100

Localities, &c.—This is the most common ore of antimony, and is found in Germany, France, and Sweden. There is only one mine of antimony in Britain, which is in the south of Scotland, near Westerhall, in the neighbourhood of Langholm.

Subspecies 4. Plumose Ore of Antimony.

Exter. Char.—Usually found in capillary crystals, so interwoven, that they form a superficial covering to other minerals: these groups are externally weakly shining; internal lustre glimmering; fracture fibrous.

Colour similar to the former, and sometimes tarnished brown or like tempered steel; opaque; soft; sometimes almost friable; brittle.

Const. Parts.—Plumose antimony is composed of sulphuret of antimony combined with arsenic, iron, and accidentally a little silver.

Chem. Char.—Before the blow-pipe this and the other varieties of gray antimony give out white fumes, with a sulphureous smell, and are almost entirely volatilized, or changed into a black slag.

Localities, &c.—Plumose antimony is found at Freyberg in Saxony, in the Hartz, and in Hungary.

3. Species.

Classification.

3. Species. Black Ore of Antimony.

Exter. Char.—Found crystallized in rectangular four-sided tables, truncated on the edges or angles; crystals smooth; lustre shining; fracture conchoidal.

Colour iron black; soft.

Localities, &c.—This species, which is also a sulphuret of antimony, combined probably with some other ingredients, is found in Cornwall.

4. Species. Red Ore of Antimony.

Id. Kirwan, ii. 250. *Id.* Brochant, ii. 379. *Antimoine Hydrosulfuré*, iv. 276.

Exter. Char.—Massive or disseminated, but most commonly in capillary crystals; lustre weakly shining, vitreous; fracture fibrous.

Colour cherry red, brown, reddish, or bluish; soft, almost friable; brittle. Specific gravity 3.7 to 4.

Chem. Char.—Before the blow-pipe it melts easily, and in nitric acid a white powder is deposited.

Constituent Parts.	Klaproth.
Oxide of antimony,	78.3
Sulphur,	19.7
Loss,	2.
	100.0

Localities, &c.—Found in Saxony and France, usually accompanying gray or native antimony.

5. Species. White Ore of Antimony.

Muriated Antimony, Kirwan, ii. 151. *Antimoine Oxidé*, Hauy, iv. 273.

Exter. Char.—Rarely massive, usually superficial, in divergent fibres, or crystallized in rectangular four-sided tables, cubes, or four-sided prisms. Crystals aggregated; smooth; streaked longitudinally; resplendent; internal lustre shining, between adamantine and pearly; fracture foliated.

Colour snow white, yellowish white, or grayish; translucent; soft; brittle.

Chem. Char.—Crystals decrepitate before the blow-pipe, but in powder is easily fusible.

Const. Parts.—Was formerly supposed to be a muriate of antimony, but according to Klaproth, it is a pure oxide. The white ore of France, according to Vauquelin, contains,

Oxide of antimony,	86
——— lead,	3
Silica,	8
Loss,	3
	100

6. Species. Ochre of Antimony.

Id. Brochant, ii. 383. *Id.* Kirwan, ii. 252.

Exter. Char.—Massive, disseminated, or in superficial crusts, on gray antimony; dull; fracture earthy.

Colour straw yellow, or yellowish gray; soft; friable.

Chem. Char.—Infusible before the blow-pipe; becomes white, and emits white fumes. Its constituents are unknown.

Localities, &c.—In Saxony and Hungary, accompanying gray and red antimony, and in the antimony mine near Westerhall, in the south of Scotland.

Metallic Ores

XII. COBALT Genus.

1. Species. White Cobalt Ore.

Id. Kirw. ii. 382. *Id.* Broch. ii. 386.

Exter. Char.—Massive, disseminated, reniform, and rarely crystallized in small four-sided tables, or in small cubes or octahedrons. Lustre weakly shining, or shining; fracture uneven.

Colour tin white, but on the surface variable, and tarnished; streak shining; hard; brittle.

Chem. Char.—Easily fusible before the blow-pipe, emitting a dense vapour, with a smell of arsenic, and leaves a white metallic globule; colours borax-blue.

Localities, &c.—Found in Norway, Sweden, and Saxony, in beds of micaceous schistus, along with red cobalt ore, quartz, and hornblende. Its composition is not known, but supposed to be alloyed with some other metals.

2. Species. Gray Cobalt Ore.

Id. Kirw. ii. 271. *Id.* Broch. ii. 388.

Exter. Char.—Massive, disseminated, reniform, and botryoidal; lustre shining; fracture even.

Colour light steel gray, or tin white; surface steel tarnished; streak shining; semi-hard; brittle.

Chem. Char.—Infusible before the blow-pipe; emitting fumes and the smell of arsenic.

Constituent Parts.	Klaproth.
Cobalt,	20
Arsenic,	33
Iron,	24
Loss,	23
	100

It contains also sometimes nickel and silver.

Localities, &c.—Found in Saxony, France, Norway, and Cornwall in England, with other ores of cobalt.

3. Species. Shining Cobalt Ore.

Id. Broch. ii. 390. Kirw. ii. 273.

Exter. Char.—Massive, disseminated, superficial, in various imitative forms, and crystallized in cubes and octahedrons, which are variously modified; crystals small, smooth, and resplendent, rarely drusy; lustre shining; fracture uneven, radiated, or fibrous.

Colour tin white, commonly grayish, or yellowish tarnished; hard; brittle. Spec. grav. 6.3 to 6.4.

Chem. Char.—Before the blow-pipe it burns with a small white flame, and a white vapour, smelling strongly of garlic; then blackens, and is almost infusible; soluble in nitric acid.

Constituent Parts of crystallized shining cobalt from Tunaberg in Sweden.

	Klaproth.	Tassaert.
Cobalt,	44.	36.66
Arsenic,	55.5	49.
Sulphur,	5	6.5
Iron,		5.66
Loss,		2.18
	100.0	100.00

Metallic Ores.

Localities, &c.—This is the most common ore of cobalt; and it is usually accompanied by the other ores, and sometimes also by vitreous, red, and native silver. It is found in Bohemia, Saxony, Sweden, and Cornwall in England, and usually in beds in primitive mountains.

Uses.—This ore of cobalt is commonly wrought for the purpose of employing it in the preparation of the fine blue colour known by the name of *smalt*, which is used in the manufacture of porcelain, glass, and as a pigment.

4. Species. Black Cobalt Ochre.

Id. Broch. ii. 396. Kirw. ii. 275. Hauy, iv. 214.

This is divided into two subspecies, friable and indurated.

Subspecies 1. Friable Cobalt Ochre.

Exter. Char.—Composed of particles which are more or less cohering; stains a little.

Colour brownish, bluish, or grayish black; streak shining; feels meagre. In other characters it agrees with the following.

Subspecies 2. Indurated Cobalt Ochre.

Exter. Char.—Massive, disseminated, in imitative forms, or marked with impressions; dull, or weakly glimmering; fracture earthy.

Colour bluish black; streak shining, resinous; soft; semihard; rather brittle. Spec. grav. 2.01 to 2.42.

Chem. Char.—Before the blow-pipe it gives out an arsenical odour, but is infusible.

Its constituent parts are supposed to be oxide of cobalt, with some iron and arsenic.

Localities, &c.—Both varieties are found together, and accompanied by ores of silver, copper, iron, in Saxony, Suabia, and the Tyrol, as well as in France and Spain.

5. Species. Brown Cobalt Ochre.

Id. Broch. ii. 400.

Exter. Char.—Massive, or disseminated; always dull; fracture earthy; streak shining, resinous.

Colour light or dark liver brown; soft, almost friable; very easily frangible.

Constituent Parts.—Supposed to be composed of oxide of cobalt and iron.

Localities, &c.—Found at Saalfeld in Thuringia, in stratiform mountains, and in Wirtemberg, in primitive mountains, accompanied by other varieties of cobalt ochre.

6. Species. Yellow Cobalt Ochre.

Id. Kirw. ii. 277. Broch. ii. 401.

Exter. Char.—Massive, or disseminated, or adhering to the surfaces of other minerals; dull; fracture earthy; streak shining, resinous.

Colour dirty straw yellow, or yellowish gray; very soft or friable.

Chem. Char.—Before the blow-pipe it gives out an odour of arsenic, and is infusible.

Its constituents are supposed to be oxide of cobalt, and a little arsenic.

Classification.

Localities, &c.—Found in the same places with the former, but is rare.

7. Species. Red Cobalt Ochre, or *Arseniate of Cobalt.*

Id. Kirw. ii. 278. Broch. ii. *Cobalt Arseniaté*, Hauy, iv. 216.

This is divided into two subspecies; earthy and radiated.

Subspecies 1. Earthy Red Cobalt Ochre.

Exter. Char.—In thin superficial layers, or crusts; dull, or weakly glimmering; fracture earthy.

Colour peach-blossom red, rose red, or reddish white; streak a little shining; very soft, friable.

Localities, &c.—Found in Bohemia, Saxony, France, and Norway.

Subspecies 2. Radiated Red Cobalt Ochre, or *Cobalt Bloom*, or *Flowers of Cobalt.*

Exter. Char.—Massive, or disseminated, rarely botryoidal or reniform; often superficial, and in small drusy crystals, whose forms are rectangular four-sided tables, four-sided prisms, double six-sided pyramids, with different modifications. Crystals small and variously aggregated, smooth and shining, sometimes resplendent; fracture radiated; fragments wedge-shaped, or splintery.

Colour peach blossom red, crimson red, or, exposed to the air, brownish, grayish, or whitish; translucent; crystals semitransparent; soft; brittle.

Chem. Char.—Before the blow-pipe becomes blackish gray, giving out a feeble odour of arsenic, without any fumes, but is infusible. Colours borax a fine blue.

This species has not been particularly analysed, but is considered as a compound of cobalt and arsenic acid.

Localities, &c.—The same as the former, and also in Cornwall in England, and along with copper ores at Alva in Scotland.

8. Species. Sulphate of Cobalt.

A saline substance in a stalactitical form, of a pale rose red colour and translucent, is found at Herrengrund near Newsohl in Hungary, which was at first supposed to be a sulphate of manganese, and afterwards a sulphate of cobalt.

This substance has been examined by Klaproth, who dissolved it in water, added an alkali, and obtained a bluish precipitate, which coloured borax of a beautiful sapphire blue; and with muriatic acid he obtained from it a sympathetic ink.

XIII. NICKEL Genus.

1. Species. Copper-coloured Nickel.

Id. Brochant, ii. 408. *Sulphurated Nickel*, Kirw. ii. 286. *Nickel Arsenical*, Hauy, iii. 518. *Kupfernickel* of the Germans.

Exter. Char.—Massive or disseminated, rarely reticulated;

Classification.

lated; shining, or weakly shining; fracture uneven, sometimes conchoidal; fragments rather sharp-edged.

Colour pale copper red, whitish, or grayish; semihard; brittle. Spec. grav. 6.64 to 7.56.

Chem. Char.—Before the blow-pipe it gives out the fumes and odour of arsenic; melts with difficulty into a slag, mixed with metallic particles. Solution in acids, green.

Constituent Parts.	Sage.
Nickel,	75
Arsenic,	22
Sulphur,	2
Loss,	1
	100

Localities, &c.—Found in veins, in primitive and stratiform mountains, almost always accompanied with ores of cobalt, and often with rich silver ores. It is found in Bohemia, Saxony, France, Spain, and Cornwall in England.

2. Species. Nickel Ochre, or *Oxide of Nickel.*

Id. Kirw. ii. 283. Broch. ii. 411. Hauy, iii. 516.

Exter. Char.—Usually disseminated and effloresceent on other minerals; composed of friable, loose, and slightly agglutinated particles.

Colour apple-green of different shades; stains; feels meagre.

Chem. Char.—Remains unchanged before the blow-pipe; colours borax yellowish red, and is insoluble in nitric acid.

Constituent Parts.	Lampadius.
Oxide of nickel,	67.
——— iron,	23.2
Water,	1.5
Loss,	8.3
	100.0

Localities, &c.—Found in similar situations with the preceding species.

XIV. MANGANESE Genus.

1. Species. Gray Ore of Manganese, or *Oxide of Manganese.*

Id. Brochant, ii. 414. *Id.* Kirwan, ii. 291. *Id.* Hauy, iv. 243.

This species is divided into four subspecies: 1. radiated; 2. foliated; 3. compact; and, 4. earthy.

Subspecies 1. Radiated Gray Ore of Manganese.

Essen. Char.—Colours borax violet.

Exter. Char.—Massive or disseminated, or crystallized in oblique four-sided prisms, or in acicular prisms fascicularly grouped together; the crystals are variously modified. Faces streaked longitudinally; shining or resplendent; fracture radiated; fragments wedge-shaped.

Metallic Ores.

Colour steel gray, or iron black; streak black, without lustre; stains; soft; brittle. Specific gravity 3.7 to 4.7.

Constituent Parts.	Cordier and Beaunier*. From France.	Germany.	Piedmont.
Oxide of manganese,	83.5	82.	86.
Brown oxide of iron,	2.	–	3.
Carbone,	–	–	1.5
Carbonate of lime,	–	7.5	–
Barytes,	1.5	3.	–
Silica,	7.5	7.	5.
Loss,	5.5	.5	4.5
	100.0	100.0	100.0

* *Jour. des Mines*, No. lviii. p. 778.

Of purer specimens by Klaproth.

Oxide of manganese,	99.25	92.75
Water,	.25	7.
Loss,	.5	.25
	100.0	100.00

Subspecies 2. Foliated Gray Ore of Manganese.

Exter. Char.—Found massive, disseminated, or crystallized in small, rectangular, four-sided tables, fascicularly grouped; lustre shining; fracture foliated.

Colour similar to the former; streak black and dull; stains; soft, and brittle. Spec. grav. 3.74.

Subspecies 3. Compact Gray Ore of Manganese.

Exter. Char.—Massive or disseminated, in angular, or botryoidal, or dendritical forms; lustre glimmering; fracture uneven, sometimes even or conchoidal

Colour steel gray, or bluish black; stains; semihard, or soft; brittle.

Const. Parts—approach pretty nearly to those of the radiated variety.

Subspecies 4. Earthy Gray Ore of Manganese.

Exter. Char.—Found massive, disseminated, sometimes superficial and dendritical; dull; sometimes a little glimmering; fracture earthy.

Colour between steel gray and bluish black; stains very much; very soft, often even friable; feels meagre.

Constituent Parts—supposed to be the same as the former, but with a larger proportion of oxide of iron.

Chem. Char.—Gray ore of manganese is infusible before the blow-pipe, but becomes of a blackish brown colour; gives a blue colour to borax.

Localities, &c.—All the varieties of this species are usually found together, and chiefly in primitive mountains. The earthy ore of manganese almost always accompanies sparry iron ore, and other ores of iron. Manganese is found in considerable abundance in Saxony, Bohemia, France, near Exeter in England, and in Aberdeenshire in Scotland.

2. Species. Black Ore of Manganese.

Exter. Char.—Found massive, disseminated, or crystallized in small four-sided double pyramids, arranged in

Metallic Ores.

in rows; surface shining; internal lustre weakly glimmering; fracture imperfectly foliated.

Colour grayish black, and brownish black; streak dull, brownish red; soft; brittle.

Localities, &c.—This species is of rare occurrence. It has been found in Thuringia, forming a crust on gray ore of manganese, and also, it is said, in Piedmont.

3. Species. Red Ore of Manganese, or *Carbonate of Manganese.*

Exter. Char.—Massive, disseminated, botryoidal, &c. or crystallized in flat rhomboids, or in very small pyramids or lenses. Surface of the crystals smooth; dull, or weakly glimmering; fracture uneven or splintery.

Colour rose red, or brownish white; translucent at the edges; semihard; brittle. Spec. grav. 3.23.

Chem. Char.—Infusible before the blow-pipe; becomes grayish black, and colours borax violet blue, or crimson red.

Constituent Parts.	Lampadius.
Oxide of manganese,	48
——— iron,	2.1
Carbonic acid,	49
Silica,	.9
	100.0

Localities, &c.—This species of manganese, which is rare, is found in Transylvania at Offenhanya, and particularly at Nagyag, where it constitutes part of the masses of an auriferous vein, from which the gold ore of Nagyag is obtained.

XV. MOLYBDENA Genus.

1. Species. Sulphuret of Molybdena.

Id. Brochant, ii. 432. *Id.* Kirwan, ii. 322. *Id.* Hauy, iv. 289.

Exter. Char.—Massive or disseminated, sometimes in plates, and rarely crystallized in equal six-sided tables; crystals small, imbedded, the lateral faces shining; internal lustre shining; fracture foliated; fragments rather blunt-edged, sometimes in plates.

Colour lead gray; opaque; stains, and writes; very soft, and easily frangible; flexible in thin plates, but not elastic; feels greasy. Spec. grav. 4.56 to 4.73.

Chem. Char.—Infusible before the blow-pipe; gives out a sulphureous smell; nitric acid converts it to a white oxide, which is the molybdic acid.

Constituent Parts.

	Pelletier.	Klaproth.
Molybdic acid,	45	60
Sulphur,	55	40
	100	100

Localities, &c.—Always found in primitive mountains, in nests or nodules, and very commonly in the neighbourhood of tin ores. It is also accompanied by wolfram, quartz, native arsenic, and fluor spar. It is found in Bohemia, Saxony, Sweden, France, and England.

Classification.

XVI. ARSENIC Genus.

1. Species. Native Arsenic.

Id. Broch. ii. 435. *Id.* Kirw. ii. 255. *Id.* Hauy, iv. 220.

Exter. Char.—Massive, disseminated, in imitative forms, or with impressions; surface rough or granulated; dull, or weakly glimmering; internal lustre weakly shining; fracture uneven, sometimes imperfectly foliated; fragments rather blunt-edged in plates.

Colour light lead gray, tin-white or grayish black when tarnished; streak shining; semihard; very easily frangible. Spec. grav. 5.72 to 5.76.

Chem. Char.—Melts readily before the blow-pipe, giving out white vapour, with the smell of garlic; then burns with a bluish flame, and is dissipated, leaving only a whitish powder, which is the oxide of arsenic.

Constituent Parts.—Native arsenic is usually alloyed with a small portion of iron, and sometimes also with a little gold or silver.

Localities, &c.—Found in veins in primitive mountains, accompanied by ores of silver, lead, copper, quartz, and earthy spars, in Bohemia, Saxony, and France.

2. Species. Arsenical Pyrites.

Id. Broch. ii. 438. *Id.* Kirw. ii. 256. *Fer Arsenical*, Hauy, iv. 56.

This is divided into two subspecies, common and argentiferous.

Subspecies 1. Common Arsenical Pyrites.

Exter. Char.—Massive, disseminated, often crystallized in oblique four-sided prisms, acute octahedrons, and lenses; the prisms being variously modified on their angles, faces, and extremities. Crystals small; lateral faces smooth, shining; bevelled faces streaked transversely; lustre shining; fracture uneven.

Colour silvery white, but usually tarnished yellow, or bluish, and iridescent; hard; brittle. Specific gravity 5.75 to 6.52.

Phys. Char.—By friction gives out the odour of garlic.

Chem. Char.—Before the blow-pipe gives out a white vapour with the odour of arsenic, the fumes depositing a white powder on cold bodies; a reddish brown matter, which is infusible, remains.

Constituent Parts.—Composed of arsenic, iron, and sulphur.

Subspecies 2. Argentiferous Arsenical Pyrites.

Exter. Char.—Rarely massive, often disseminated, and crystallized in small, acicular, four-sided prisms; lustre shining, or weakly shining; fracture uneven.

Colour tin-white, or silvery-white, usually tarnished.

Localities, &c.—Arsenical pyrites is found in Bohemia, Saxony, and Silesia, in veins of primitive mountains, or disseminated in the rocks.

The second variety is found in similar places, and differs only from the first, in being combined with a small quantity of silver, which varies from 1 to 10 per cent.

3. Species.

Classification. Metallic Ores.

3. Species. ORPIMENT.

Id. Kir. ii. 260. *Id.* Broch. ii. 444. Hauy, iv. 234.

This species is divided into two subspecies, yellow and red.

Subspecies 1. YELLOW ORPIMENT.

Exter. Char.—Massive, disseminated, superficial, and crystallized in oblique four-sided prisms, bevelled at the extremity, or terminated by a four-sided pyramid, or in acute octahedrons. Crystals small, and confusedly aggregated; surface smooth; that of the bevelment and pyramids finely streaked; internal lustre resplendent, between resinous and adamantine; fracture foliated; fragments in plates.

Colour citron-yellow, golden-yellow, or aurora-red; translucent; in thin plates, semitransparent; soft; flexible in thin plates. Spec. grav. 3.31 to 3.45.

Chem. Char.—Gives out a blue flame before the blow-pipe, with white vapour, and the smell of arsenic and sulphur.

Constituent Parts.

	Kirwan.	Westrumb.
Arsenic,	84	80
Sulphur,	16	20
	100	100

Localities, &c.—Usually found in stratiform mountains, accompanied by clay, quartz, and sometimes by red orpiment, in Transylvania, Hungary, and other places.

Subspecies 2. RED ORPIMENT.

Exter. Char.—Rarely massive, usually disseminated, or superficial, and often crystallized in oblique four-sided prisms, with obtuse lateral edges, truncated, or bevelled: crystals small, streaked longitudinally; shining or resplendent; internal lustre shining between vitreous and resinous; fracture uneven, or conchoidal.

Colour light aurora-red, scarlet-red, orange yellow; translucent or semitransparent, often opaque; streak orange, or citron-yellow; very soft: somewhat brittle. Spec. grav. 3.2.

Chem. Char.—Similar to the former.

Constituent Parts.—According to some, the same as the preceding, but with the addition of iron and silica, with a smaller proportion of sulphur.

Localities, &c.—Chiefly found in primitive mountains, as in Saxony, Hungary, France, and in the neighbourhood of Ætna and Vesuvius.

4. Species. NATIVE OXIDE OF ARSENIC.

Id. Kirw. ii. 258. *Id.* Broch. ii. 450. *Id.* Hauy, iv. 225.

Exter. Char.—Found superficial in an earthy form, and friable, on other minerals; rarely indurated, sometimes botryoidal, or crystallized in capillary crystals, very small octahedrons, or four-sided tables; lustre glimmering or dull; fracture earthy or fibrous.

Colour snow-white, yellowish white, reddish or greenish white; opaque; crystals translucent; soft, or friable. Spec. grav. 3.706.

Chem. Char.—Before the blow-pipe it gives out a white fume and a garlic odour; burns with a bluish flame, and is entirely dissipated; soluble in water and acids.

Constituent Parts.—This is a pure oxide of arsenic, with an accidental mixture of earth.

Localities, &c.—A rare mineral, but is found in small quantity, along with native arsenic, and ores of cobalt, in Bohemia and Hungary.

5. Species. PHARMACOLITE, or *Arseniate of Lime.*

Id. Broch. ii. 523. *Chaux Arseniaté*, Hauy, ii. 293.

Exter. Char.—Found in small capillary crystals; lustre glimmering, silky; fracture fibrous or radiated.

Colour snow-white; translucent; very soft. Specific gravity 2.53 to 2.64.

Chem. Char.—Soluble in nitric acid with effervescence, and gives out the odour of arsenic before the blow-pipe.

Constituent Parts.	Klaproth.
Arsenic acid,	50.54
Lime,	25.
Water,	24.46
	100.00*

* *Analyt. Ess.* ii. 23.

Localities, &c.—Found in a vein in primitive rocks, accompanied by heavy spar and gypsum, near Wittichen in Suabia. It has also been found in France.

XVII. TUNGSTEN GENUS.

1. Species. WOLFRAM.

Id. Kirw. ii. 316. *Id.* Broch. ii. 456. *Schеelin Ferruginé*, Hauy, iv. 314.

Exter. Char.—Found massive, disseminated, or crystallized in six-sided prisms, and in rectangular four-sided tables, which are variously modified. Crystals not very small, usually grouped; internal lustre shining or resplendent; longitudinal fracture foliated; cross fracture uneven.

Colour brownish black, or perfect black, sometimes tarnished; opaque; streak dark reddish brown; soft; brittle. Spec. grav. 7.11 to 7.33.

Chem. Char.—Before the blow-pipe it decrepitates, but is infusible.

Constituent Parts.

	Delhuyart.	Wiegleb.	Klaproth	Vauquelin.
Tungstic acid,	65	35.75	46.9	67.
Oxide of manganese,	22	32.	–	6.25
Oxide of iron,	13	11.	31.2	18.
Silica,	–	–	–	1.5
Loss,	–	21.25	21.9	7.25
	100	100.00	100.00	100.00

Localities, &c.—Wolfram, which is a rare mineral, is found in primitive mountains, accompanied by quartz, and

Metallic Ores

and tin ores, in Bohemia, France, and Cornwall in England.

2. Species. Tungstate of Lime.

Tungsten, Kirw. ii. 314. *Id.* Broch. ii. 453. *Scheelin Calcaire*, Hauy, iv. 320.

Exter. Char.—Massive, disseminated, sometimes crystallized in regular octahedrons, which are sometimes slightly bevelled on the edges of the common base. Crystals usually small; surface smooth, resplendent; bevelled surface streaked transversely; internal lustre shining or resplendent, resinous or adamantine; fracture foliated.

Colour grayish or yellowish white; translucent; semi-hard; brittle. Spec. grav. 6.06.

Chem. Char.—Before the blow-pipe decrepitates, and loses its transparency, but is infusible. Reduced to powder, and digested with nitric or muriatic acid, it leaves a citron yellow residuum, which is tungstic acid.

Constituent Parts. Klaproth.

Oxide of tungsten,	77·75	75.25
——— iron,	–	1.25
——— manganese,	–	·75
Lime,	17.6	18.7
Silica,	3·	1·5
Loss,	1.65	2.55
	100.00	100.00

Localities, &c.—This is a rare mineral, usually found in primitive mountains, accompanied by ores of tin, some iron ores, quartz, fluor spar, &c. in Sweden, Saxony, and Cornwall in England.

XVIII. TITANIUM Genus.

1. Species. Menachanite.

Id. Brochant, ii. 468. *Id.* Kirwan, ii. 326. Hauy, iv. 305.

Exter. Char.—Found in small, detached, rounded grains; surface rough, or weakly glimmering; lustre shining, semi-metallic; fracture imperfectly foliated.

Colour grayish or iron black; soft or semi-hard; brittle. Spec. grav. 4.4.

Chem. Char.—Infusible before the blow-pipe; colours borax greenish brown.

Constituent Parts.

	Chenevix.	Klaproth.
Oxide of titanium,	45·25	40
——— iron,	51.	49
Silica,	3·5	11
Oxide of manganese,	2.5	–
	100.00	100

Localities, &c.—This mineral was first discovered by Mr Gregor, among sand, in the bed of a rivulet, in the valley of Menachan in Cornwall; hence its name. It has since been found in the island of Providence, one of the Bahamas, and at Botany Bay in New Holland.

2. Species. Octahedrite.

Classification.

Anatase, Hauy, iii. 129. *Id.* Brochant, ii. 548. *Octahedrite*, Saussure, Voyages, § 1901.

Exter. Char.—Found only crystallized, in elongated octahedrons with square bases, and truncated or acuminated; crystals small and imbedded; lateral faces streaked transversely; lustre resplendent, vitreous; fracture foliated.

Colour steel gray, sometimes light indigo blue; translucent; semi-hard; brittle. Spec. grav. 3.85.

Chem. Char.—Infusible before the blow-pipe, but melts with borax, which it colours green, and in cooling, crystallizes in needles.

Const. Parts.—It is chiefly composed of oxide of titanium.

Localities, &c.—Has been found lining the cavities of a vein, accompanied by quartz and feldspar, in a primitive rock, in Dauphiné in France.

3. Species. Titanite.

Id. Kirwan, ii. 329. *Le Ruthile*, Brochant, ii. 470. *Titane Oxidé*, Hauy, iv. 296. *Red Schorl* of many.

Exter. Char.—Found crystallized in oblique four-sided prisms, the lateral edges truncated; sometimes these crystals are double, being united obliquely; also in acicular and capillary crystals, imbedded and grouped together; surface longitudinally streaked, shining; internal lustre shining, adamantine; fracture foliated.

Colour blood-red or reddish brown; opaque, or translucent; hard; brittle. Spec. grav. 4.1 to 4.24.

Chem. Char.—Infusible before the blow-pipe, but loses its transparency, and becomes gray.

Const. Parts.—Composed chiefly of oxide of titanium.

Localities, &c.—Found in Hungary, in gneiss, and imbedded in quartz. It has been found also in Switzerland, Spain, and France.

4. Species. Nigrine.

Kirwan, ii. 331. Brochant, ii. 474. Hauy, iv. 307.

Exter. Char.—Disseminated, sometimes amorphous, often crystallized in oblique four-sided prisms, variously modified by truncations and bevelments. Surface smooth; lustre shining, or resplendent, between resinous and vitreous; fracture foliated.

Colour dark brownish black, yellowish white or violet brown; opaque, or translucent; semi-hard. Spec. grav. 3.51 to 4.6.

Chem. Char.—Infusible before the blow-pipe.

Constituent Parts.

	Klaproth.	Abilgaard.	
Oxide of titanium,	33	58	74
Silica,	35	22	8
Lime,	32	20	18
	100	100	100

Localities, &c.—Found in Bavaria, and at Arendal in Norway.

5. Species.

Classification.

5. Species. Brown Ore of Titanium.

This species in its characters so nearly resembles the preceding, that it may be considered merely as a variety, as has been done by Brochant and Hauy.

6. Species. Iserine.

Id. Brochant, ii. 478.

Exter. Char.—Found in rounded or angular grains, having a rough and glimmering surface; internally shining; fracture conchoidal.

Colour iron black, or brownish; hard; brittle. Spec. grav. 4.5.

Chem. Char.—Melts before the blow-pipe into a dark brown slag.

Constituent Parts.	Klaproth.
Oxide of titanium,	59.1
——— iron,	30.1
——— uranium,	10.2
Loss,	.6
	100.0

Localities, &c—Found in the sand of a river in Bohemia, called *Iser*, whence the name is derived.

XIX. URANIUM Genus.

1. Species. Pitchy Ore of Uranium.

Id. Brochant, ii. 460. Kirw. ii. 305. Hauy, iv. 280.

Exter. Char.—Massive, disseminated, sometimes cellular; shining or glimmering; fracture imperfectly conchoidal; fragments rather sharp-edged.

Colour velvet black, iron black, or bluish, sometimes steel-tarnished; streak black; opaque; semi-hard; brittle. Spec. grav. 6.5 to 7.5.

Chem. Char.—Infusible before the blow-pipe; soluable in nitric acid.

Constituent Parts.	Klaproth.
Uranium a little oxidated,	86.5
Sulphuret of lead,	6.
Oxide of iron,	2.5
Silica,	5.
	100.0

Localities, &c.—Found in Bohemia and Saxony, accompanying galena, copper pyrites, iron ochre, and some ores of silver and cobalt.

2. Species. Micaceous Uranite.

Id. Brochant, ii. 463. Kirwan, ii. 304.

Exter. Char.—Sometimes in thin layers, but often crystallized in rectangular four-sided tables; in cubes, and six-sided prisms variously modified. Crystals small, and grouped together; lustre shining, pearly; fracture foliated.

Colour emerald or grass green of various shades, rarely wax yellow; translucent; streak greenish white; soft; not very brittle. Spec. grav. 3.12. Metallic Ores.

Chem. Char.—Soluble, without effervescence, in nitric acid, which it colours citron yellow.

Const. Parts.—This species is an oxide of uranium, with a small portion of copper.

Localities, &c.—Found in Saxony, France, and Cornwall in England, accompanied by some ores of iron, sometimes by cobalt.

3. Species. Uranite Ochre.

Id. Broch. ii. 466. *Id.* Kirw. ii. 303.

Exter. Char.—Found massive, but usually disseminated, or superficial; is dull, or rarely shining; fracture earthy, or foliated; fragments blunt-edged.

Colour citron yellow, aurora red, or sulphur yellow; opaque; soft and friable; brittle; stains a little; feels meagre. Spec. grav. 3.15 to 3.24.

Constituent Parts.—Composed of oxide of uranium, with a portion of iron.

Localities, &c.—Found in similar places with the former.

XX. TELLURIUM Genus.

1. Species. Native Tellurium.

Id. Broch. ii. 480. *Sylvanite*, Kirw. ii. 324. Hauy, iv. 325.

Exter. Char.—Massive or disseminated; shining; fracture foliated.

Colour between tin and silvery white; soft; not very brittle. Spec. grav. 5.7 to 6.1.

Chem. Char.—Melts easily before the blow-pipe.

Constituent Parts.	Klaproth.
Tellurium,	92.6
Iron,	7.2
Gold,	.2
	100.0

Localities, &c.—Has been only found at Fatzebay in Transylvania, where it exists in veins, in mountains of gray wacken and transition limestone. The ore is dug out for the purpose of extracting the gold.

It was called *aurum paradoxum*, and *aurum problematicum*, because its external appearance did not indicate that it contained gold.

2. Species. Graphic Ore of Tellurium.

Id. Broch. ii. 482. Hauy. iv. 327.

Exter. Char.—Massive and crystallized in flat four or six-sided prisms, which are arranged in rows, exhibiting something of the appearance of written characters, and hence the name graphic ore. Surface smooth, shining; longitudinal fracture foliated and resplendent; cross fracture uneven.

Colour tin white, yellowish, or lead gray; soft and brittle. Spec. grav. 5.72.

Chem. Char.—Burns with a greenish flame before the blow-pipe.

Constituent Parts.	Klaproth.
Tellurium,	60
Gold,	30
Silver,	10
	100

Localities, &c.—Has only been found at Offenbanya in Transylvania, in veins traversing porphyry and granular limestone accompanied by iron pyrites and copper ore. It is wrought for the sake of the gold.

3. Species. YELLOW ORE OF TELLURIUM.

Id. Broch. ii. 484. Hauy, iv. 327.

Exter. Char.—Disseminated, and crystallized in small four-sided prisms; shining, or weakly shining; fracture foliated; cross fracture uneven.

Colour silver white, brass yellow, or gray.

Chem. Char.—Soluble in nitric acid.

Constituent Parts.	Klaproth.
Tellurium,	44·75
Gold,	26.75
Lead,	19.5
Silver,	8.5
Sulphur,	·5
	100.00

Localities, &c.—Found only at Nagyag in Transylvania.

4. Species. BLACK OR FOLIATED ORE OF TELLURIUM.

Id. Broch. ii. 486. Hauy, iv. 327.

Exter. Char.—Found in plates, which are united into masses, or disseminated, rarely crystallized in six-sided tables; surface smooth, shining; external lustre resplendent; fracture foliated.

Colour between lead gray and iron black; stains; soft; flexible in thin plates. Spec. grav. 8.91.

Chem. Char.—Before the blow-pipe the sulphur and tellurium are dissipated in white fumes, and a metallic globule remains, surrounded by a black slag.

Constituent Parts.	Klaproth.
Tellurium,	33.
Lead,	50.
Gold,	8.5
Siver and copper,	1.
Sulphur,	7·5
	100.0

Localities, &c.—Found only in the same place with the preceding.

XXI. CHROMIUM GENUS.

1. Species. NEEDLE ORE OF CHROMIUM.

Exter. Char.—Found in small crystals, which are imbedded; lustre shining; fracture uneven or conchoidal.

Colour steel gray, and usually covered with a greenish efflorescence; soft, or semihard; not very brittle.

Constituent Parts.—This is supposed to be an alloy of chromium.

Exter. Char. &c.—Found in the gold mine of Rudnick near Schlangenberg in Suabia, in a matrix of white quartz, containing gold and galena.

2. Species. OCHRE OF CHROMIUM.

Exter. Char.—Massive, disseminated, and in thin plates; dull; fracture uneven or earthy.

Colour verdigris green, or yellowish; soft.

Localities, &c.—Found only in the same place, accompanying the former.

The chromates of lead and iron have been already described among the ores of those metals.

XXII. COLUMBIUM GENUS.

Exter. Char.—Massive; fracture uneven, or foliated; lustre shining.

Colour dark gray; opaque; not very hard; brittle. Spec. grav. 5.918.

Constituent Parts.	
Oxide of columbium,	78
——— iron,	21
Loss,	1
	100

Localities, &c.—This mineral, of which the only specimen known is in the British Museum, was brought from Massachussets in America; it was analyzed by Mr Hatchett, and found to contain a new metal, which he denominated *columbium*.

XXIII. TANTALIUM GENUS.

Two species of this mineral have been discovered; tantalite, and yttrio-tantalite.

1. Species. TANTALITE.

Exter. Char.—Crystallized in octahedrons; surface smooth; fracture compact.

Colour bluish gray, or black. Spec. grav. 7.95.

Constituent Parts.—Composed of tantalium, iron, and manganese.

Localities, &c.—Found in Finland, in globular pieces, in a vein of red feldspar, traversing a gneiss rock.

2. Species. YTTRIO-TANTALITE.

Exter. Char.—Disseminated, in pieces of the size of a nut; fracture even; lustre metallic.

Colour dark gray; may be scratched with a knife; powder gray. Spec. grav. 5.13.

Constituent Parts.—Composed of iron, manganese, tantalium, and the new earth yttria.

Localities, &c.—Found at Ytterby in Sweden, in the same place with gadolinite.

These minerals were analyzed by Eckeberg, who discovered in them the new metal tantalium, which is now supposed to be the same with columbium.

Classification.

XXIV. CERIUM Genus.

1. Species. CERITE.

Exter. Char.—Found massive or disseminated; lustre weakly glimmering; fracture fine grained, even.

Colour pale rose red; opaque; powder grayish; scratches glass. Spec. grav. 4.5 to 4.9.

Chem. Char.—Infusible before the blow-pipe, and does not colour borax.

Constituent Parts.

	Vauquelin.	Klaproth.
Oxide of cerium,	67.	54·5
——— iron,	.02	4.
Silica,	17.	34.
Lime,	.02	
Water and carbonic acid,	.12	5.
Loss,	15.84	2.5
	100.00	100.0

Localities, &c.—This mineral has been found in the copper mines of Bastnaes, at Riddarhytta, in Sweden, accompanied by copper, molybdena, bismuth, mica, and hornblende.

The new metal contained in this mineral was discovered by Hisinger and Berzelius, chemists at Stockholm.

Metallic Ores.

Exter. Char.—Found massive; shining, vitreous; fracture conchoidal.

Colour velvet black, or brownish black; opaque; hard; scratches quartz; brittle. Spec. grav. 4.04.

Chem. Char.—Reduced to powder, and heated in diluted nitric acid, it is converted into a thick yellowish gray jelly. Before the blow-pipe it decrepitates and becomes whitish red, but remains infusible.

Constituent Parts.

	Eckeberg.	Vauquelin.	Klaproth.
Yttria,	47·5	35.	59·75
Silica,	25.	25.5	21.25
Lime,		2.	
Alumina,	4·5		·5
Oxide of iron,	18.	25.	17·5
——— manganese,		2.	
Water and carbonic acid,		10.5	·5
Loss,	5.		·5
	100.0	100.0	100.00

Localities, &c.—This mineral was examined by Professor Gadolin of Sweden, whose name it bears, and found to contain a peculiar earth. It was found near Ytterby in Sweden, and hence the new earth was called *Yttria*.

APPENDIX.

IX. YTTRIAN Genus.

To follow Strontian Genus, p. 209.

Species. GADOLINITE.

Id. Brochant, ii. 512. *Id.* Hauy, iii. 141.

The unavoidable length to which the first part of this treatise has extended, and some other circumstances, render it necessary for us to introduce in a different part of the work, what we propose to lay before our readers in the second part relative to the analysis of stones and metallurgical operations. See ORES, *Reduction of*, and STONES, *Analysis of*.

EXPLANATION OF THE PLATES.

PLATE CCCLI.

Fig. 1. Represents the goniometer or graphometer, an instrument invented by Carangeau for measuring the angles of crystals. MTN is a graduated semicircle of brass or silver, furnished with two arms or rulers AB, FG, one of which, FG, has a slit from *a* to R, excepting the cross bar at K, which strengthens the instrument. This arm is fixed to a brass ruler at R and *c* placed behind, and which makes part of the semicircle. The arm FG is connected with the ruler behind by nails which enter the slit and are furnished with nuts. The other arm has also a slit or opening from *x* to *c*, where it is fixed to the first by the screw nail which passes through both. By slackening the screws, the two parts *c* G and *c* B may be shortened at pleasure. The arm AB being only fixed at *c*, which is the centre of the circle, moves round this centre, while the arm GF remains constantly fixed in the direction of the diameter which passes through the points 0 and 180°. The upper part of the arm AB should be brought to a thin edge from *z* to *s*, and the line of this edge should pass through the centre *c*; because it is by this edge that the measure of the angle on the graduated circumference is indicated.

To discover the measure of any angle of a crystal, the two arms *c* B, *c* G are brought into contact with the sides containing the angle, and the degree indicated by the line *z s* on the circumference denotes the measure of that angle. The instrument is so contrived that the arms may be shortened for the convenience of applying it in different cases. But it might happen that it could not be applied in cases where the crystals are aggregated or attached to the matrix. This difficulty is obviated by another contrivance. The semicircle is furnished with a hinge at 90°, by which means it may be diminished at pleasure to a quadrant, by folding back one half. There is a small bar of steel, one end of which is fixed behind the immoveable arm FG, and the other is attached by a notch and screw nail at O. When this nail is unscrewed, the bar *c* O falls behind the ruler which supports FG, and thus one half of the semicircle folds back, and any angle not exceeding 90° may be measured; but when the angle is greater, it must be replaced.

Fig. 2. is an apparatus by which small degrees of

Explanation of the Plates.

electricity may be observed in minerals. A is a small brass needle with knobs *a b*, and moveable on the pivot at the middle. The mineral whose electricity is to be tried, is rubbed on silk or woollen, and then presented to one of the knobs; and by the distance at which the knob begins to be attracted, the strength of the electricity may be, in some degree, estimated. In the same way substances which become electric by heat, such as the tourmaline, are to be tried; the same apparatus may be employed. To ascertain in what part of the mineral the different electricities exist, take a stick of sealing wax, at the extremity of which a silk thread has been attached, and having rubbed the wax, bring alternately the opposite extremities of the substance, for example, each of the summits of a tourmaline, within a small distance of the silk thread. If the extremity which is brought near the thread possess negative electricity, the thread will be repelled; on the contrary, it will be attracted. Or the experiment may be made in another way, particularly when the electrical body is small, or its electricity feeble. At B, fig. 2. the tourmaline *t t'* is held by a pair of pincers in such a way that the pole *t* is at a small distance from the knob *a* of the needle. C *c* is the stick of wax, one of whose extremities is placed on a tube of glass U *u*, and which acts by its extremity C, on the knob *a*, to excite in it positive electricity. In this case the wax, after the extremity which has been rubbed is placed in the position described, communicates to the knob of the needle to which it is presented, an electricity contrary to its own; so that the extremity of the tourmaline acted on by positive electricity, repels the needle to which it is presented, and the other extremity, possessing negative electricity, attracts the needle.

Fig. 3. is a spirit of wine blow-pipe, nearly on the plan of that invented by Mr Paul. It is made of brass, and consists of the following parts.

a Is a hollow oval frame about five inches in its longest dimension, which supports the pillar *d* and the two lamps *b c*, which may burn either oil or alcohol, but the latter is the best. The rim *c e* slips upon the pillar *d* as low as the shoulder of the latter will permit, but the rim may be raised at pleasure and kept fast by the screw peg *f*. The rim supports the boiler *g*, which is a single hollow piece of thick brass containing about an ounce of alcohol, and has four openings, viz. three at top *h*, *i*, *k*, and one at bottom to receive the tube *o*. This latter is long enough to reach the level of the outside of the top of the boiler, and consequently the alcohol within the boiler cannot readily boil over into the tube and the opening *k* which corresponds with it, is closely shut by a screw stopper, hollowed out a little beneath, to allow the free passage of the vapour down the tube. Here the vaporized alcohol is prevented from condensing at the point *o* by the contiguity of the flame of the lamp *b*, and as it passes on through the hollow *p q* into the jet tube *r*, it is immediately kindled by the flame of the lamp *c*, and the united flames are compelled sideways with such violence as to form a long pencil of blue flame, attended with a considerable roaring noise. This continues as long as any alcohol is left in the boiler, which allows ample time for most blow-pipe operations. The boiler is filled at the opening *h*. The centre hole *i* is nicely fitted with a small brass plug kept down by a thin slip of iron *l*, the other end of which slips over the top of the upright pillar *d*, and is confined between two flat screw-plates *m n*. The use of this is as a safety valve to take away all danger of the boiler bursting by the confined vapour not being able to escape fast enough through the jet-pipe *r*, for when the internal pressure is great, the elasticity of the iron spring *l* allows the valve *i* to rise sufficiently to let out part of the enclosed vapour. The screw stoppers *h* and *k* are made still tighter by collars of leather, as is the part where the tube *o* joins the boiler. The jet-pipe *r* has a complete rotatory motion, so that the flame may be impelled in any direction. This is effected by turning in the form of a ball that part of the pipe which is inclosed in the hollow *p q*.

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But this blow-pipe, although an elegant philosophical apparatus, will not be found to answer where a great degree of heat is required to be kept up for a considerable time. Other contrivances, therefore, of a simpler nature, have been proposed; and perhaps the best of these is the blow-pipe which is used by the mouth. The following is a description of a blow-pipe of this kind.

Fig. 4. represents this blow-pipe. *a* Is a brass tube, having a circular enlargement *c*, for the purpose of condensing the moisture which is blown from the lungs; the smaller end *d* is moveable round the centre *c*, so that any degree of obliquity may be given to the flame. Fig. 5. is a separate jet-pipe with a small opening, which is screwed on the blow-pipe at *d*; and it may be convenient to have two or three jet-pipes of different sizes, according as a larger and more moderate, or a smaller and more intense flame is wanted. *b* Is a piece of ivory which slips on the larger end, for the purpose of being applied to the mouth, as being more agreeable.

The best kind of flame for blowing through with the common blow-pipe is a wax or tallow candle with a very large wick, which should be kept snuffed moderately low, and the wick turned a little aside from the pipe. A spirit lamp is sometimes used, which makes a perfectly clear flame without smoke, but weak when used in this way. There is a kind of knack in blowing with the mouth, which is not easily described, and requires a little practice to be performed with ease. As the flame must often be kept for several minutes, the act of respiration must be carried on through the nostrils without interruption, and the stress of blowing must be performed merely by compression of the cheeks upon the air in the mouth.

The substance to be heated is placed either on a piece of charcoal or a metallic support. When the former is used, a large close well-burnt piece of charcoal must be chosen, a small shallow hole scooped out with a knife, and the substance laid upon it. The charcoal itself kindles all round the hole, and the hole is thus gradually enlarged; and the heat too is kept up round the substance much more uniformly than when a metal support is used. At the same time however the chemical effect produced by heated charcoal should not be forgotten, particularly the reduction of metallic oxides, and the deoxygenation of the fixed acids; so that, for example, a small heap of minium or litharge heated red-hot on charcoal

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charcoal by the blow-pipe, is speedily reduced to a globule of metallic lead; the phosphates are partially reduced to phosphurets, &c.

For a metallic support, platina is in general by far the best material. A small spoon of this metal, the shank of which may be stuck in a cork when held, and a small silver cup, the shank of which is fixed into a wooden handle, may be used in fusions with borax or alkaline fluxes. A small forceps lately brought into use, and made entirely of two thin pieces of platina joined by rivets, and bent, will be useful in holding any small hard substance in the blow-pipe flame for any length of time, without danger of the points of the forceps melting; and it is also found that this metal is so much worse a conductor of heat than any other, that the forceps never gets too hot for the naked fingers to touch at the bend *.

* *Aikin's Dict. of Chemistry, &c. Appendix.*

Fig. 6. represents a portable pocket blow-pipe, invented by Dr Wollaston, and of its actual size. The interior tube is longer than the exterior, that it may be readily withdrawn; and the upper edge of the large end is turned outward, to diminish the effort of the lips requisite for retaining it in the mouth.

Fig. 7. represents the whole apparatus, one half of its real dimensions, and connected for use. The small extremity *a* is placed obliquely at an angle of about 120°, that the flame impelled by it may be carried to a more convenient distance from the eye, and thus answering the purpose of a longer blow-pipe. This oblique piece *a* is composed of three parts, the largest of which is made stronger, that it may not be injured by use. One end is closed, and into the other is inserted a small peg of wood, perforated so as to receive the tip which is intended to be occasionally separated, for the purpose of passing a fine needle into it, to remove obstructions †.

† *Nich. Jour.* xv. 284.

Plates CCCLII. and CCCLIII.

Fig. 1. *Diamond*,—spheroidal, with 48 convex faces.

Fig. 2. *Zircon*,—the primitive form an octahedron with isosceles triangles.

Fig. 3. *Zircon*,—rectangular four-sided prism terminated by a four-sided pyramid set on the lateral faces.

Fig. 4. *Hyacinth*,—a dodecahedron formed from a rectangular four sided prism terminated by a four-sided pyramid set on the lateral edges.

Fig. 5. *Chrysoberyl*,—double six-sided pyramid flattened, having the summits truncated.

Fig. 6. *Chrysolite*,—a compressed eight-sided prism, terminated by an eight-sided pyramid, whose sides correspond to those of the prism, and whose summit is truncated by a convex surface.

Fig. 7. *Augite*,—the primitive form, an oblique four-sided prism with rhomboidal bases.

Fig. 8. *Common form of augite*,—a short, eight-sided, compressed prism, terminated by two oblique faces.

Fig. 9. *Pistazite*,— a six-sided prism with two broad and four narrow faces, and bevelled at the extremities.

Fig. 10. and 11. other forms in which the prisms are terminated by several oblique faces with a truncated summit.

Fig. 12. *Vesuvian*,—a four-sided prism with the edges truncated, and terminated by four oblique and one horizontal face.

Fig. 13. *Garnet*,—primitive form, a rhomboidal dodecahedron. Explanation of the Plates.

Fig. 14. *Trapezoidal garnet*,—composed of 24 faces, which are equal and similar trapezoids.

Fig. 15. *Grenatite*,—a six-sided prism with the greater angles at each base truncated.

Fig. 16. Two crystals of the same crossing each other obliquely. *Staurotide, oblique angle*, of Hauy.

Fig. 17. *Corundum*,—two six-sided pyramids united by the bases, with the summits and angles truncated.

Fig. 18. A six-sided prism, having the alternate angles at each base truncated.

Fig. 19. *Topaz*,—an eight-sided prism terminated by an obtuse four-sided pyramid at one extremity, and by a different one at the other.

Fig. 20. A similar prism with six of the terminal edges truncated.

Fig. 22. *Tourmaline*,—primitive form, which is an obtuse rhomboid.

Fig. 23. A nine-sided prism, terminated at one extremity by a six-sided summit, and by a three-sided summit at the other.

Fig. 24. Same prism, with a three and a seven-sided summit at the extremities.

Fig. 25. *Axinite* or *Thumerstone*,—primitive form, which is a rectangular four-sided prism, whose bases are oblique-angled parallelograms.

Fig. 26. A secondary form, same prism, having the alternate lateral and terminal edges truncated.

Fig. 27. *Rock-crystal*.—A double six-sided pyramid.

Fig. 28. A six-sided prism, terminated at each extremity by a six-sided pyramid, having the alternate angles at the opposite bases slightly truncated.

Fig. 29. *Feldspar*,—the primitive form, which is an oblique-angled parallelopiped.

Fig. 30. An oblique four-sided prism.

Fig. 31. A six-sided prism with four of the angles truncated, and the two extremities bevelled.

Fig. 32. The same prism, with four of the terminal edges truncated.

Fig 33. An oblique four-sided prism, bevelled and truncated at the extremities.

Fig. 34. *Chiastolite*,—the outer rhomboid marked with black lines parallel to the sides of the black internal rhomboid.

Fig. 35. *Foliated Zeolite*, or *Stilbite*,—compressed four-sided prism, terminated by a four-sided summit set on the lateral edges.

Fig. 36. A six-sided prism with two solid angles at each extremity, truncated.

Fig. 37. *Cubic Zeolite*, or *Analcime*,—the cube with all the solid angles truncated.

Fig. 38. *Cubic Zeolite*, or *Chabasie*,—composed of three rhomboids.

Fig. 39. *Cross-stone*,—a double crystal composed of two dodecahedrons crossing each other at right angles.

Fig. 40. *Hornblende*,—primitive form, an oblique four-sided prism, whose base is a rhomboid.

Fig. 41. *Basaltic Hornblende*,—a six-sided prism terminated at one extremity by four trapezoidal planes; and at the other by a bevelment, the planes of which are pentagons.

Fig. 42. *Tremolite*,—an oblique four-sided prism, having the acute angles truncated and terminated by a dihedral summit.

Fig.

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Fig. 1.

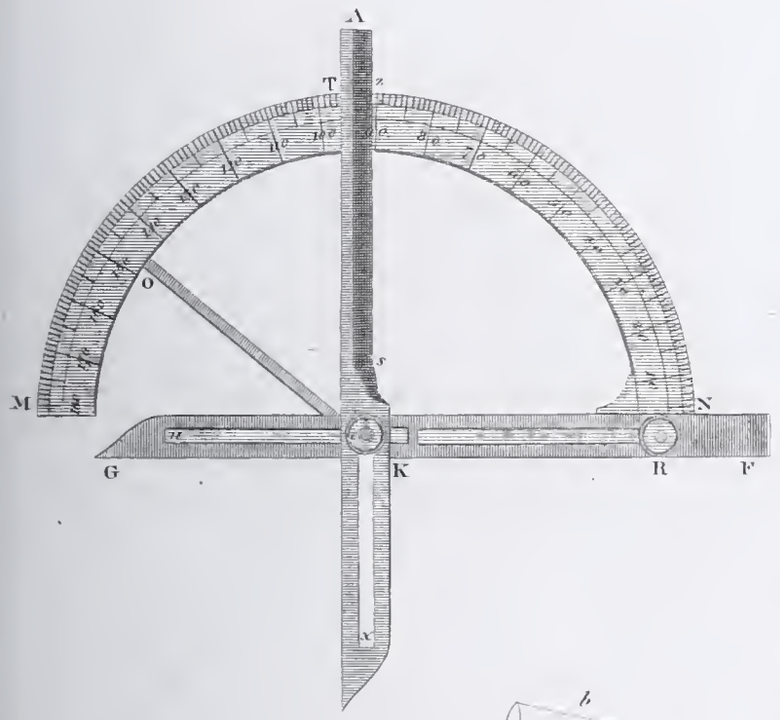


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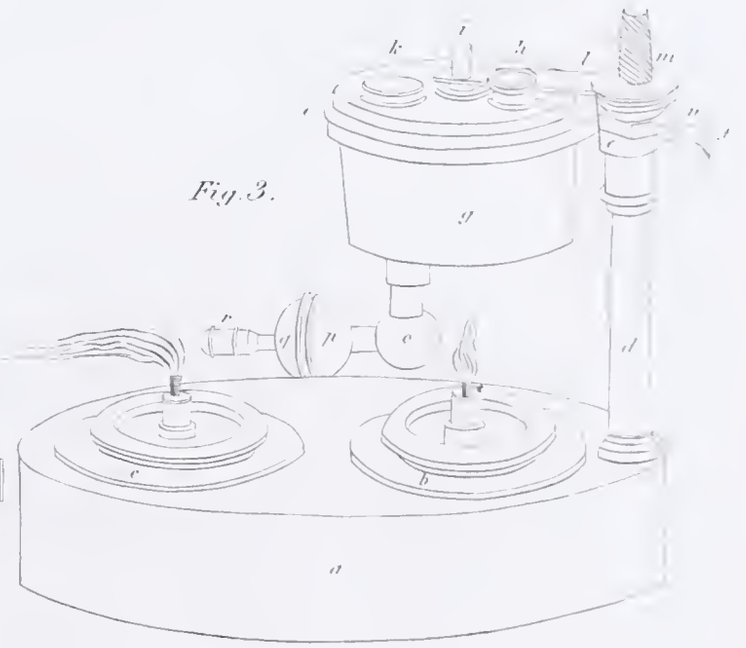


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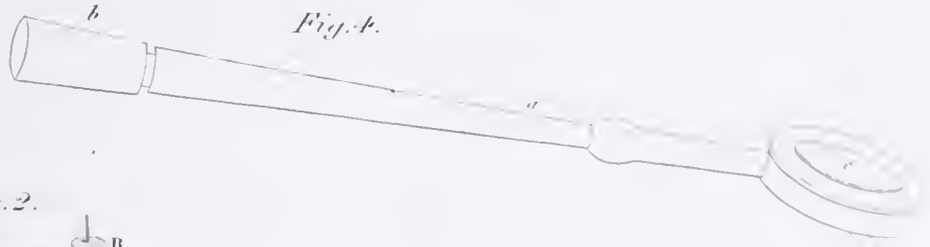


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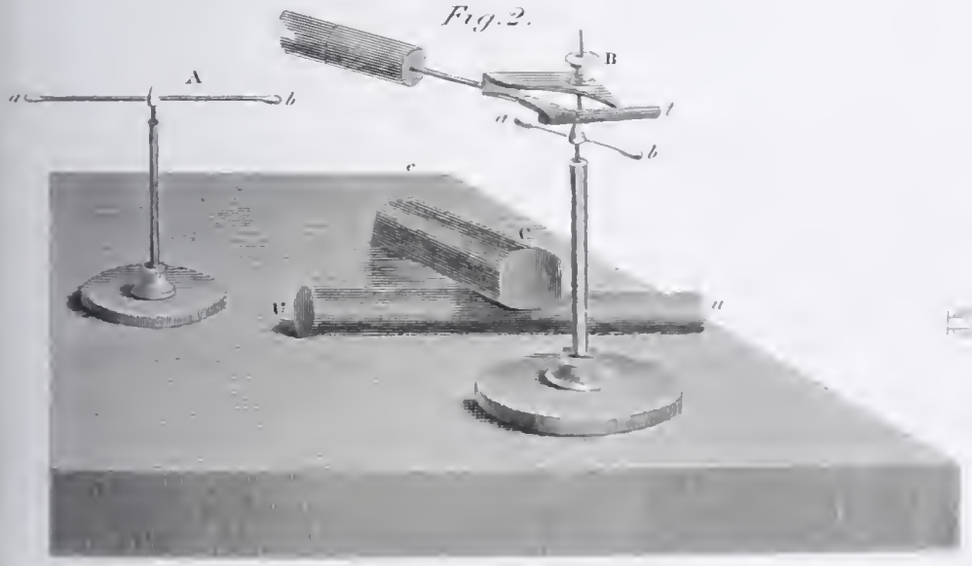


Fig. 5



Fig. 6.



Fig. 7



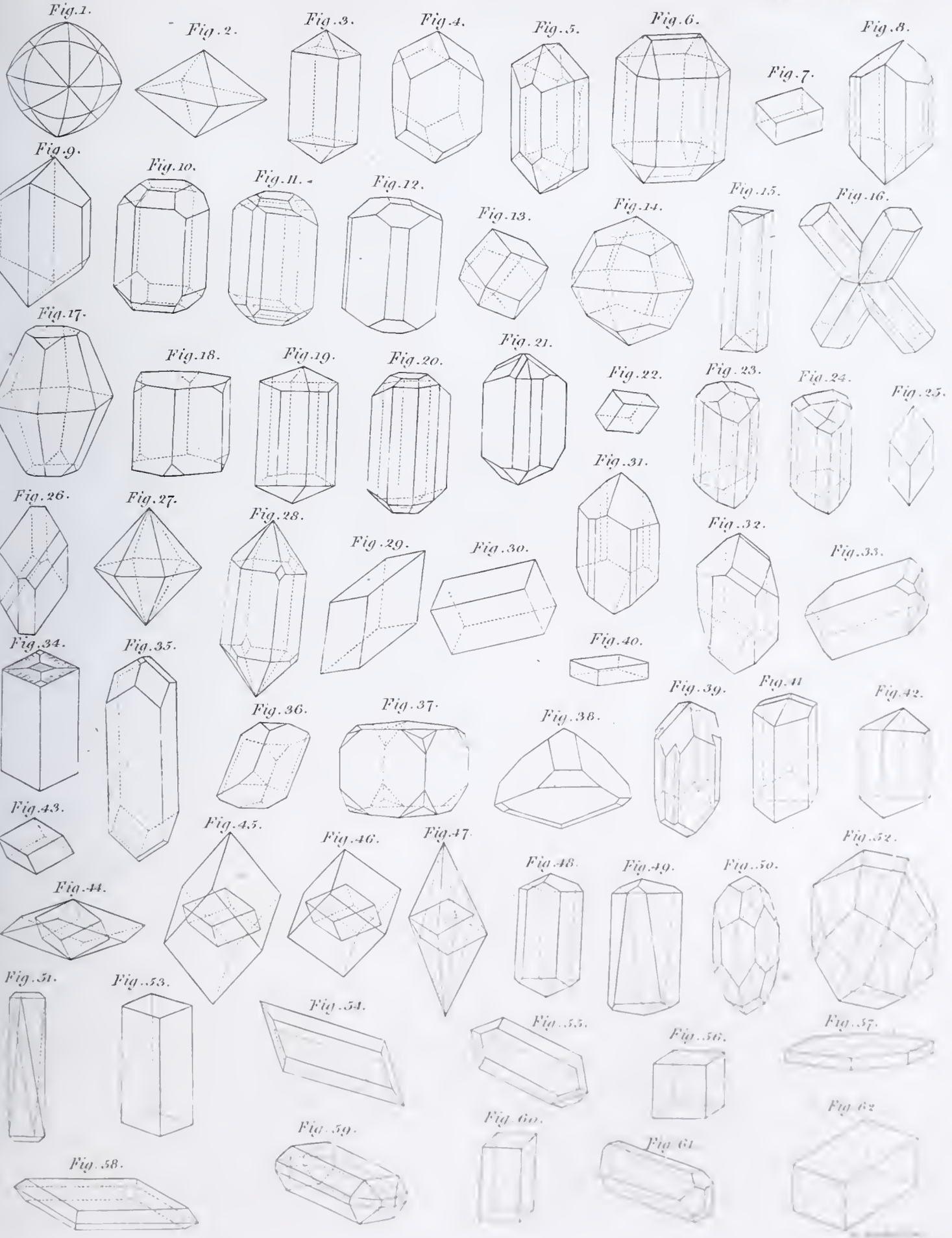

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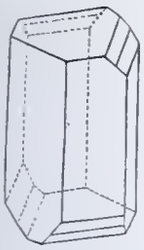


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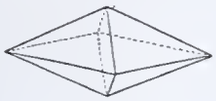


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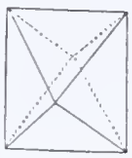


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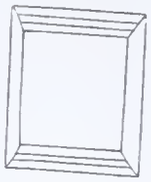


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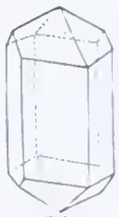


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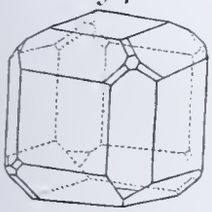


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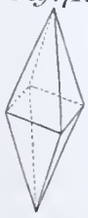


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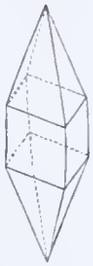


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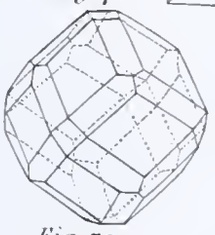


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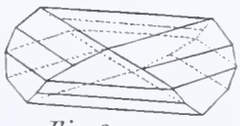


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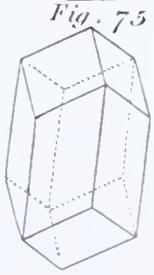


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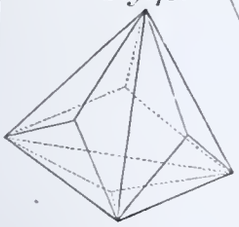


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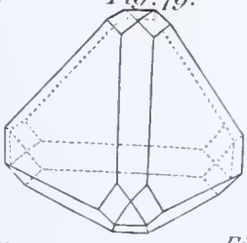


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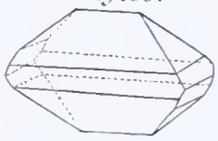


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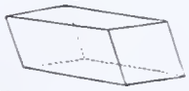


Fig.82.

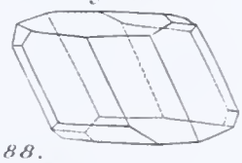


Fig.83.



Fig.84.

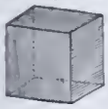


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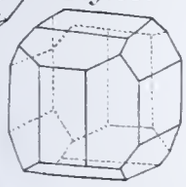


Fig.86.

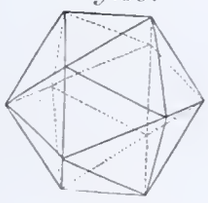


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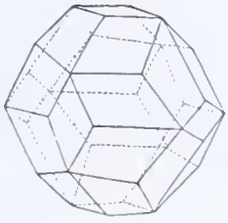


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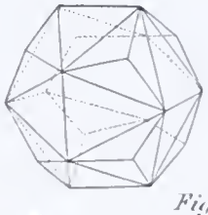


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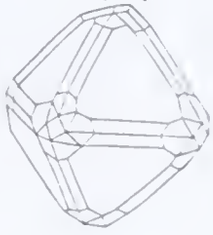


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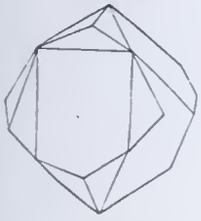


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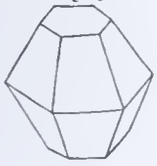


Fig.92.



Fig.93.



Fig.94.



Fig.95.



Fig.96.



Fig.97.

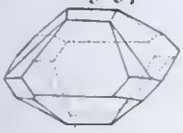


Fig.98.

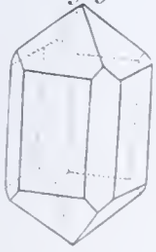


Fig.99.



Fig.100.

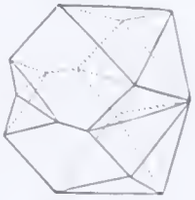


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Fig.102.



Fig.103.

Fig.104.

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MIN

MIN

Minerva || Mingrelia.

MINERVA, or PALLAS, in Pagan worship, the goddess of sciences and of wisdom, sprung completely armed from Jupiter's brain: and on the day of her nativity it rained gold at Rhodes. She disputed with Neptune the honour of giving a name to the city of Athens; when they agreed that whosoever of them should produce what was most useful to mankind, should have that advantage. Neptune, with a stroke of his trident, formed a horse; and Minerva caused an olive to spring from the ground, which was judged to be most useful, from its being the symbol of peace. Minerva changed Arachne into a spider, for pretending to excel her in making tapestry. She fought the giants; favoured Cadmus, Ulysses, and other heroes; and refused to marry Vulcan, choosing rather to live in a state of celibacy. She also deprived Tiresias of sight, turned Medusa's locks into snakes, and performed several other exploits.

Minerva is usually represented by the poets, painters and sculptors, completely armed, with a composed but agreeable countenance, bearing a golden breastplate, a spear in her right hand, and her ægis or shield in the left, on which is represented Medusa's head encircled with snakes, and her helmet was usually entwined with olives.

Minerva had several temples both in Greece and Italy. The usual victim offered her was a white heifer, never yoked. The animals sacred to her were the cock, the owl, and the basilisk.

Minervæ Castrum, *Arx Minervæ*, *Minervium*, or *Templum Minervæ*, in *Ancient Geography*, a citadel, temple, and town on the Ionian sea, beyond Hydrus; seen a great way out at sea. Now *Castro*, a town of Otranto in Naples. E. Long. 19. 25. N. Lat. 46. 8.

Minervæ Promontorium, in *Ancient Geography*, the seat of the Sirens, a promontory in the Sinus Paestanus, the south boundary of Campania on the Tuscan coast; so called from a temple of Minerva on it; situated to the south of Surrentum, and therefore called *Surrentium*. Now *Capo della Minerva*, on the west coast of Naples, over against the island Capri.

MINERVALIA, in Roman antiquity, festivals celebrated in honour of Minerva, in the month of March; at which time the scholars had a vacation, and usually made a present to their masters, called from this festival *Minerval*.

MINGRELIA, anciently COLCHIS, a part of Western Georgia, in Asia; bounded on the east by Iberia, or *Georgia* properly so called; on the west, by the Euxine sea; on the south, by Armenia, and part of Pontus; and on the north, by Mount Caucasus. Mingrelia.

Colchis, or Mingrelia, is watered by a great many rivers; as the Corax, the Hippus, the Cyaneus, the Charistus, the Phasis, where the Argonauts landed, the Absarus, the Cissa, and the Ophis, all emptying themselves into the Euxine sea. The Phasis does not spring from the mountains in Armenia, near the sources of the Euphrates, the Araxes, and the Tigris, as Strabo, Pliny, Ptolemy, Dionysius, and after them Arrian, Reland, Calmet, and Sanson, have falsely asserted; but rises in Mount Caucasus; and flows not from south to north, but from north to south, as appears from the map of Colchis or Mingrelia in Thevenot's collection, and the account which Sir John Chardin gives of that country. This river forms in its course a small island called also *Phasis*: whence the pheasants, if Isidorus is to be credited, were first brought to Europe, and thence called by the Greeks *Phasiani*. The other rivers of Colchis are considerable.

The whole kingdom of Colchis was in ancient times very pleasant and fruitful, as it is still where duly cultivated; abounded in all necessaries of life; and was enriched with many mines of gold, which gave occasion to the fable of the Golden Fleece and the Argonautic expedition, so much celebrated by the ancients.

Sir John Chardin tells us, that this country extends above 100 miles in length and 60 in breadth; being not near so extensive as the ancient Colchis, which reached from the frontiers of Iberia or Georgia Proper, westward to the Palus Mæotis: that it is beautifully diversified with hills, mountains, valleys, woods, and plains, but badly cultivated: that there are all the kinds of fruits which are found in England, growing wild, but tasteless and insipid for want of culture: that, if the natives understood the art of making wines, those of this country would be the finest in the world: that there are many rivers which have their source in Mount Caucasus, particularly the Phasis, now called the *Rione*: that the country abounds in beeves, hogs, wild boars, stags, and other venison; and in partridges, pheasants, and quails: that falcons, eagles, pelicans, lions, leopards, tygers, wolves, and jackals, breed on Mount Caucasus, and sometimes greatly annoy the country: that the people are generally handsome, the men strong and well made, and the women very beautiful; but both sexes very vicious and debauched: that they marry their nieces, aunts, or other relations, indifferently; and take two or three

wives

Mingrelia. wives if they please, and as many concubines as they will: that they not only make a common practice of selling their children, but even murder them, or bury them alive, when they find it difficult to bring them up: that the common people use a sort of paste, made of a plant called *gom*, instead of bread; but that of the better sort consists of wheat, barley, or rice: that the gentry have an absolute power over their vassals, which extends to life, liberty, and estate: that their arms are the bow and arrow, the lance, the sabre or broad-sword, and the buckler: that they are very nasty, and eat sitting cross-legged upon a carpet, like the Persians; but the poorer sort upon a mat or bench, in the same posture: that the country is very thin of inhabitants, no less than 12,000 being supposed to be sold yearly to the Turks and Persians: that the principal commodities exported from it are, honey, wax, hides, castor, martens skins, flax seed, thread, silk, and linen cloth; but that there are no gold or silver mines now, and very little money: that the revenue of the prince or viceroy amounts to about 20,000 crowns per annum: that the inhabitants calls themselves *Christians;* but that both they and their priests are altogether illiterate, and ignorant of the doctrines and precepts of Christianity: that their bishops are rich, have a great number of vassals, and are clothed in scarlet and velvet; and that their service is according to the rites of the Greek church, with a mixture of Judaism and Paganism. Mingrelia || Miniature.

The cities of most note in this country in ancient times were Pityus; Dioscurias, or Dioscorias, which was so called from Castor and Pollux, two of the Argonauts, by whom it is supposed to have been founded, and who in Greek are styled *Dioscuroi*, at present known by the name of *Savatapoli;* Aea on the Phasis, supposed to be the same as Hupolis; *Phasis*, so called from the river on which it stood; Cyta, at the mouth of the river Cyaneus, the birth place of the famous Medea, called from thence, by the poets, *Cytæis;* Saracæ, Zadris, Surium, Madia, and Zolissa. As for modern cities, it does not appear that there are any here considerable enough to merit a description; or, if there are, they seem to be little, if at all, known to Europeans.

MINHO, a great river in Spain, which taking its rise in Galicia, divides that province from Portugal, and falls into the Atlantic at Caminha.

MINIATURE, in a general sense, signifies representation in a small compass, or less than the reality.

MINIATURE PAINTING,

A DELICATE kind of painting, consisting of little points or dots; usually done on vellum, ivory, or paper, with very thin, simple, water colours.—The word comes from the Latin *minium*, "red lead;" that being a colour much used in this kind of painting. The French frequently call it *mignature*, from *mignon*, "fine, pretty," on account of its smallness and delicacy: and it may be ultimately derived from μικρος, "small."

Miniature is distinguished from other kinds of painting by the smallness and delicacy of its figures and faintness of the colouring; on which account it requires to be viewed very near.

Sect. I. *Of Drawing and Designing.*

To succeed in this art, a man should be perfectly skilled in the art of designing or drawing: but as most people who affect the one, know little or nothing of the other, and would have the pleasure of painting without giving themselves the trouble of learning to design (which is indeed an art that is not acquired without a great deal of time, and continual application), inventions have been found out to supply the place of it; by means of which a man designs or draws without knowing how to design.

The first is chalking: that is, if you have a mind to do a print or design in miniature, the backside of it, on another paper, must be blackened with small coal, and then rubbed very hard with the finger wrapped in a linen cloth: afterwards the cloth must be lightly drawn over the side so blackened that no black grains may remain upon it to soil the vellum you would paint upon; and the print or draught must be fastened upon the vellum with four pins, to keep it from shifting. And if it be another paper that is blackened, it must be put between the vellum and the print, or draught, with the blackened side upon the vellum. Then, with a blunted pin or needle, you must pass over the principal lines or strokes of the print, or draught, the contours, the plaits of the drapery, and over every thing else that must be distinguished; pressing so hard, that the strokes may be fairly marked upon the vellum underneath.

Copying by squares is another convenient method for such as are but little skilled in the art of designing, and would copy pictures, or other things, that cannot be chalked. The method is this: The piece must be divided into many equal parts by little squares, marked out with charcoal, if the piece be clear and whitish, and the black can be fairly seen upon it; or with white chalk, if it be too brown and dusky. After which, as many squares of equal dimensions must be made on white paper, upon which the piece must be designed; because, if this be done immediately upon vellum, (as one is apt to miscarry in the first attempt), the vellum may be soiled with false touches. But when it is neatly done upon paper, it must be chalked upon the vellum in the manner before described. When the original and the paper are thus ordered, observe what is in each square of the piece to be designed; as a head, an arm, a hand, and so forth; and place it in the corresponding part of the paper. And thus finding where to place all the parts of the piece, you have nothing to do but to form them well, and to join them together. By this method you may reduce or enlarge a piece to what compass you please, making the squares of your paper greater or less than those of the original; but they must always be of an equal number.

To copy a picture, or other thing, in the same size

Drawing and Designing.

and proportion, another method is, to make use of varnished paper, or of the skin of a hog's bladder, very transparent, such as is to be had at the gold-beaters. Talc or isinglass will likewise do as well. Lay any one of those things upon your piece; through it you will see all the strokes and touches, which are to be drawn upon it with a crayon or pencil. Then take it off; and fastening it under paper or vellum, set up both against the light in the manner of a window; and with a crayon, or a silver needle, mark out upon the paper or vellum you have put uppermost, all the lines and touches you shall see drawn upon the varnished paper, bladder, talc, or isinglass, you have made use of, and which will plainly appear through this window.

After this manner, making use of the window, or of glass exposed to the light, you may copy all sorts of prints, designs, and other pieces on paper or vellum: laying and fastening them under the paper or vellum upon which you would draw them. And it is a very good and a very easy contrivance for doing pieces of the same size and proportion.

If you have a mind to make pieces look another way, there is nothing to be done but to turn them; laying the printed or drawn side upon the glass, and fastening the paper or vellum upon the back of it; remembering to let your lights fall on the left side.

A good method likewise to take a true copy of a picture in oil, is to give a touch of the pencil upon all the principal strokes, with lake tempered with oil; and to clap upon the whole a paper of the same size: then passing the hand over it, the touches of the lake will stick and leave the design of your piece expressed upon the paper, which may be chalked like other things. But you must remember to take off with the crumb of bread what remains of the lake upon the picture before it be dry.

You must likewise make use of pounce, made of powdered charcoal put in a linen rag; with which the piece you would copy must be rubbed, after you have pricked all the principal strokes or touches, and fastened white paper or vellum underneath.

When the piece is marked out upon the vellum, you must pass with a pencil of very clear carmine over all the traces, that they may not be effaced as you work: then clean your vellum with the crumb of bread, that no black may remain upon it.

The vellum must be pasted upon a plate of brass or wood, of the size you would make your piece, to keep it firm and tight. But this pasting must be on the edges of your vellum only, and behind the plate, for which purpose your vellum must exceed your plate above an inch on every side; for the part you paint upon must never be pasted; because it would not only give it an ill look, but you could not take it off if you would. Cut off the little shags and locks of the vellum; and wetting the fair side with a linen cloth dipped in water, clap the other upon the plate with a clean paper between them: so much as hangs over must be pasted upon the back of the plate, drawing it equally on all sides, and hard enough to stretch it well.

Sect. II. *Of Materials.*

The chief colours made use of for painting in miniature are,

Colours, &c.

Carmine.
Venice and Florence lake.
Rose pink.
Vermilion.
Red lead.
Brown red.
Red orpiment.
Ultramarine.
Verditer.
Indigo.
Gall stone.
Yellow ochre.
Dutch pink.
Gamboge.
Naples yellow.
Pale masticot.
Deep yellow masticot.
Ivory black.
Lamp black.
True Indian ink.
Bistre, or wood soot.
Raw umber.
Burnt umber.
Sap green.
Verdigris.
Flake white.
Crayons of all colours.
Gold and silver shells.
Leaf gold and leaf silver.

The seven transparent colours, which are used where writing is seen through the colour.

Liquid { Lake. Blue. Yellow. Grass-green. Dark-green. Purple colour. Brown.

Most of these colours necessary for miniature painting may easily be prepared by attending to the directions given under the article *Colour-Making*.

As colours taken from earth and other heavy matter are always too coarse be they never so well ground, especially for delicate work, because of a certain sand remaining in them; the finest parts may be drawn out by diluting them with the finger in a cup of water. When they are well steeped, let them settle a while: then pour out the clearest, which will be at top, into another vessel. This will be the finest, and must be let dry; and when it is used, must be diluted with gum water.

If you mix a little of the gall of an ox, a carp, or an eel, particularly of the last, in green, black, gray, yellow, and brown, colours, it will not only take away their greasy nature, but also give them a lustre and brightness they have not of themselves. The gall of eels must be taken out when they are skinned, and hung upon a nail to dry; and when you would use it, it must be diluted with brandy; add a little of it mixed with the colour you have diluted already. This likewise makes the colour stick better to the vellum, which it hardly does when it is greasy: moreover, this gall hinders it from scaling.

Some

Colours, &c.

Some colours are made clearer by fire; as yellow, ochre, brown red, ultramarine, and umber: all others are darkened by it. But if you heat the said colours with a sharp fire, they change; for the brown red becomes yellow; yellow ochre becomes red; umber reddens also. Ceruss by fire takes the colour of citron, and is often called *masticot*. Observe, that yellow ochre heated, becomes more tender than it was, and softer than brown red. Likewise brown red heated becomes softer than fine yellow ochre. Both are very proper. The finest and truest ultramarine, heated upon a red-hot iron, becomes more glittering; but it wastes, and is coarser and harder to work with in miniature.

All these colours are diluted in little cups of ivory, made on purpose, or in sea shells, with water in which gum arabic and sugar candy are put. For instance, in a glass of water put a piece of gum as big as a walnut, and half that quantity of sugarcandy. This last hinders the colours from scaling when they are laid on, which they generally do when they want it, or the vellum is greasy.

This gum water must be kept in a neat bottle corked; and you never must take any out of it with a pencil that has colour upon it, but with a quill or some such thing.

Some of this water is put in the shell with the colour you would temper, and diluted with the finger till it be very fine. If it be too hard, you must let it soften in the shell with the said water before you dilute it. Afterwards let it dry; and do thus with every colour, except lily-green, sap-green, and gamboge, which must be tempered with fair water only. But ultramarine, lake, and bistre, are to be more gummed than other colours.

If you make use of sea shells, you must let them steep two or three days beforehand in water: then cleanse them in boiling hot water, mixed with vinegar, in order to carry off a certain salt, which otherwise sticks to them, and spoils the colours that are put to them.

To know whether colours are sufficiently gummed, you have nothing to do but to give a stroke of the pencil upon your hand when they are diluted, which dries immediately: if they chap and scale, there is too much gum; if they rub out by passing the finger over them, there is too little. It may be seen likewise when the colours are laid on the vellum, by passing the finger over them. If they stick to it like a powder, it is a sign there is not gum enough, and more must be put to the water with which you temper them: but take care you do not put too much; for that makes the colour extremely hard and dry. It may be known likewise by their glueiness and brightness: so the more they are gummed, the darker they paint; and when you have a mind to give a greater strength to a colour than it has of itself, you have nothing to do but to give it a great deal of gum.

Provide yourself with an ivory pallet, very smooth, as big as your hand; on one side of which the colours for the carnation, or naked parts of a picture, are to be ranged in the following manner. In the middle put a great deal of white, pretty largely spread; because it is the colour most made use of: and upon the edge, from the left to the right, place the following colours at a little distance from the white.

Colours, &c.

Masticot.
Dutch pink.
Orpiment.
Yellow ochre.
Green; composed of verditer, Dutch pink, and white, in equal quantities.
Blue; made of ultramarine, indigo, and white, to a great degree of paleness.
Vermilion.
Carmine.
Bistre, and
Black.

On the other side of the pallet, spread some white in the same manner as for the carnation. And when you have a mind to paint draperies, or other things, place near the white the colour you would make them of, in order to work, as shall be shown hereafter.

The use of good pencils is a great matter. In order to make a good choice, wet them a little; and if the hairs keep close together as you turn them upon the finger, and make but one point, they are good: but if they close not together, but make several points, and some are longer than others, they are good for nothing. When they are too sharp pointed, with only four or five hairs longer than the rest, yet closing all together, they are, notwithstanding, good; but they must be blunted with a pair of scissars, taking care at the same time you do not clip away too much. It is proper to have two or three sorts of them; the largest for laying the grounds and dead colouring, and the smallest for finishing.

To bring the hairs of your pencil to join close together and make a good point, you must often put the pencil just between your lips when you are at work; moistening and pressing it close with the tongue, even when there is colour upon it; for if there be too much, some of it is taken off by this means, and enough left for giving fine and equal touches. You need not apprehend this will do you any harm. None of the colours for miniature, except orpiment, when they are prepared, have either ill taste or ill quality. This expedient must especially be used for dotting, and for finishing, particularly the naked parts of a picture, that the touches may be neat and fair, and not too much charged with colour. As for draperies and other things, as well in dead colouring as in finishing, it is sufficient, in order to make the hairs of your pencil join well, and to unload it when it has too much colour, to draw it upon the edge of the shell, or upon the paper you must put upon your work to rest your hand on, giving some strokes upon it before you work upon your piece.

To work well in miniature, you must do it in a room that has but one window, and fix yourself very near it, with a table and desk almost as high as the window; placing yourself in such a manner, that the light may always come in on the left side, and never forward or on the right.

When you would lay a colour on all parts equally strong, as for a ground, you must make your mixtures in shells, and put in enough for the thing you design to paint; for if there be not enough, it is a great chance but the colour you mix afterwards is too dark or too light.

Of Working.

Sect. III. *Of Working.*

After having spoke of vellum, pencils, and colours, let us now show how they are to be employed. In the first place, then, when you would paint a piece, be it carnation, drapery, or any thing else, you must begin by dead-colouring; that is to say, by laying your colours on with liberal strokes of the pencil, in the smoothest manner you can, as the painters do in oil; not giving it all the force it is to have for a finishing; that is, make the lights a little brighter, and the shades less dark, than they ought to be; because in dotting upon them, as you must do after dead-colouring, the colour is always fortified, and would at last be too dark.

There are several ways of dotting; and every painter has his own. Some make their dots perfectly round; others make them a little longish; others hatch by little strokes that cross each other every way, till the work appears as if it had been wrought with dots. This last method is the best, the boldest, and the soonest done: wherefore such as would paint in miniature ought to use it, and to inure themselves from the first to dot in the plump and the soft way; that is to say, where the dots are lost, in a manner, in the ground upon which you work, and only so much appears as is sufficient to make the work seem dotted. The hard and the dry way is quite the reverse, and always to be avoided. This is done by dotting with a colour much darker than your ground, and when the pencil is not moistened enough with the colour, which makes the work seem rough and uneven.

Study likewise carefully to lose and drown your colours one in another, so that it may not appear where they disjoin; and to this end, soften or allay your touches with colours that partake of both, in such sort that it may not appear to be your touches which cut and disjoin them. By the word *cut*, we are to understand what manifestly separates and divides, and does not run in and blend itself with the neighbouring colours; which is rarely practised but upon the borders of drapery.

When your pieces are finished, to heighten them a little, give them a fine air; that is to say, give, upon the extremity of the lights, small touches with a colour yet lighter, which must be lost and drowned with the rest.

When the colours are dry upon your pallet or in your shells, in order to use them they must be diluted with water. And when you perceive they want gum, which is seen when they easily rub off the hand or the vellum if you give a touch with them upon either, they must be tempered with gum water instead of pure water, till they are in condition.

There are several sorts of grounds for pictures and portraitures. Some are wholly dark, composed of bistre, umbre, and Cologn earth, with a little black and white; others more yellow, in which is mixed a great deal of ochre; others grayer, which partake of indigo. In order to paint a ground, make a wash of the colour or mixture you would have it, or according to that of the picture or portraiture you would copy; that is to say, a very light lay, in which there is hardly any thing but water, in order to soak the vellum. Then pass another lay over that, somewhat thicker, and strike it on very smoothly with large strokes as quick as you can, not touching twice in the same place before it be dry; because the second stroke carries off what has been laid on at the first, especially when you lean a little too light upon the pencil.

Other dark grounds are likewise made of a colour a little greenish; and those are most in use, and the properest to lay under all sorts of figures and portraitures; because they make the carnation, or naked parts of a picture, appear very fine; are laid on very easily, and there is no occasion to dot them, as one is often obliged to do the others, which are rarely made smooth and even at the first; whereas in these one seldom fails of success at the first bout. To make them, you must mix black, Dutch pink, and white, all together: more or less of each colour, according as you would have them darker or lighter. You are to make one lay very light, and then a thicker, as of the first grounds. You may also make them of other colours, if you please; but these are the most common.

When you paint a holy person upon one of these grounds, and would paint a small glory round the head of your figure, you must not lay the colour too thick in that part, or you may even lay none at all, especially where this glory is to be very bright; but lay for the first time with white and a little ochre mixed together, of a sufficient thickness; and in proportion as you go from the place of the head, put a little more ochre; and to make it lose itself, and die away with the colour of the ground, hatch with a free stroke of the pencil, following the round of the glory sometimes with the colour of which it is made, and sometimes with that of the ground, mixing a little white or ochre with the last when it paints too dark to work with: and do this till one be insensibly lost in another, and nothing can be seen to disjoin them.

To fill an entire ground with a glory, the brightest part is laid on with a little ochre and white, adding more of the first in proportion as you come nearer the edges of the picture: and when the ochre is not strong enough (for you must always paint darker and darker), add gall stone, afterwards a little carmine, and lastly bistre. This first laying, or dead colouring, is to be made as soft as possible; that is to say, let these shadowings lose themselves in one another without gap or intersection. Then the way is to dot upon them with the same colours, in order to drown the whole together; which is pretty tedious, and a little difficult, especially when there are clouds of glory on the ground. Their lights must be fortified in proportion as you remove from the figure, and finished as the rest, by dotting and rounding the clouds; the bright and obscure parts of which must run insensibly into one another.

For a day sky, take ultramarine and a good deal of white, and mix them together. With this make a lay, as smooth as you can, with a large pencil and liberal strokes, as for grounds; applying it paler and paler as you descend towards the horizon; which must be done with vermilion or red lead, and with white of the same strength with that where the sky ends, or something less; making this blue lose itself in the red, which you bring down to the skirts of the earth, or tops of houses; mixing towards the end gall stone and

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a good deal of white, in such a manner that the mixture be still paler than the former, without any visible intersection or parting between all these colours of the sky.

When there are clouds in the sky, you may spare the places where they are to be; that is to say, you need not lay on any blue there, but form them, if they are reddish, with vermilion gall stone and white, with a little indigo; and if they are more upon the black, put in a good deal of the last; painting the lights of one and the other with masticot, vermilion, and white, more or less of any of these colours, according to the strength you would give them, or according to that of the original you copy; rounding the whole as you dot; for it is a difficult matter to lay them very smooth at the first painting: and if the sky is not even enough, you must dot it also.

It is at your pleasure to exempt the places of the clouds, for you may lay them upon the ground of the sky; heightening the bright parts by putting a good deal of white, and fortifying the shadows by using less. This is the shortest way.

A night or stormy sky, is done with indigo, black, and white, mixed together; which is laid as for a day sky. To this mixture must be added ochre, vermilion, or brown red, for the clouds; the lights of which are to be of masticot or red lead, and a little white, now redder, now yellower, at discretion. And when it is a tempestuous sky, and lightning appears in some places, be it blue or red, it is to be done as in a day sky, drowning and losing the whole together at the first forming or dead colouring, and at the finishing.

Sect. IV. *Of Draperies.*

To paint a blue drapery, put ultramarine near the white upon your pallet; and mix a part of the one with the other, till it makes a fine pale, and has a body. With this mixture you must form the brightest parts; and then adding more ultramarine, form such as are darker; and go on after this manner till you come to the deepest plaits and the thickest shades, where you must lay pure ultramarine: and all this must be done as for a first forming or dead colouring; that is to say, laying the colour on with free strokes of the pencil, yet as smooth as you can; losing the lights in the shadows with a colour neither so pale as the light nor so dark as the shades. Then dot with the same colour as in the first forming, but a small matter deeper; that the dots may be fairly seen. All the parts must be drowned one in another, and the plaits appear without intersection. When the ultramarine is not dark enough to make the deeper shadows, how well soever it be gummed, mix a little indigo with it to finish them. And when the extremities of the lights are not bright enough, heighten them with white and a very little ultramarine.

A drapery of carmine is done in the same manner as the blue; except that in the darkest places there is to be a lay of pure vermilion, before you dead colour with carmine, which must be applied at top; and in the strongest shades, it must be gummed very much. To deepen it the more, mix a little bistre with it.

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There is likewise made another red drapery, which is first drawn with vermilion, mixing white with it to dead colour the bright places, laying it pure and unmixed for those that are darker, and adding carmine for the grand shades. It is finished afterwards, like other draperies, with the same colours. And when the carmine with the vermilion do not darken enough, work with the first alone, but only in the deepest of the shades.

A drapery of lake is made in the same manner with that of carmine; mixing a good deal of white with it for the bright places, and very little for those that are dark. It is finished likewise with dotting; but you have nothing to do with vermilion in it.

Violet draperies are likewise done after this manner; after making a mixture of carmine and ultramarine, putting always white for the bright parts. If you would have your violet be columbine or dove colour, there must be more carmine than ultramarine: but if you would have it bluer and deeper, put more ultramarine than carmine.

A drapery is made of a flesh colour, beginning with a lay made of white, vermilion, and very pale lake; and making the shades with the same colours, using less white in them. This drapery must be very pale and tender, because the stuff of this colour is thin and light; and even the shades of it ought not to be deep.

To make a yellow drapery, put a lay of masticot over all; then one of gamboge upon that, excepting the brightest places, where the masticot must be left entire; the dead colour with ochre, mixed with a little gamboge and masticot, putting more or less of the last according to the strength of the shades. And when these colours do not darken enough, add gall stone. And gall stone pure and unmixed is used for the thickest shades; mixing a little bistre with it, if there be occasion to make them still darker. You finish by dotting with the same colours you dead-coloured with, and losing the lights and the shades in one another.

If you put Naples yellow, or Dutch pink, in lieu of masticot and gamboge, you will make another sort of yellow.

The green drapery is made by a general lay of verditer; with which, if you find it too blue, mix masticot for the lights, and gamboge for the shades. Afterwards add to this mixture lily-green or sap-green, to shadow with; and as the shades are thicker, put more of these last greens, and even work with them pure and unmixed where they are to be extremely dark. You finish with the same colours, a little darker.

By putting more yellow, or more blue, in these colours, you may make different sorts of green as you please.

To make a black drapery, you dead colour with black and white, and finish with the same colour, putting more black as the shades are thicker; and for the darkest, mix indigo with it, especially when you would have the drapery appear like velvet. You may always give some touches with a brighter colour, to heighten the lights of any drapery whatsoever.

A white woollen drapery is made by a lay of white, in which there must be a very small matter of ochre, orpiment, or gall stone, that it may look a little yellowish

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lowish. Then dead-colour, and finish the shades with blue, a little black, white, and bistre; putting a great deal of the last in the darkest.

The light gray is begun with black and white, and finished with the same colour deeper.

For a brown drapery, make a lay of bistre, white, and a little brown red; and shadow with this mixture, made a little darker.

There are other draperies called *variable*, because the lights are of a different colour from the shades. These are mostly used for the vestments of angels, for young and gay people, for scarfs and other airy attire, admitting of a great many folds, and flowing at the pleasure of the wind. The most common are the violets: of which they make two sorts; one, where the lights are blue; and the other, where they are yellow.

For the first, put a lay of ultramarine and very pale white upon the lights; and shadow with carmine, ultramarine, and white, as for a drapery wholly violet; so that only the grand lights appear blue. Yet they must be dotted with violet, in which there is a great deal of white, and lost insensibly in the shades.

The other is done by putting upon the lights only, instead of blue, a lay of masticot; working the rest as in the drapery all violet, excepting that it must be dotted, and the light parts blended with the shadowy, that is, the yellow with the violet, with a little gamboge.

The carmine red is done like the last; that is, let the lights be done with masticot, and the shades with carmine; and to lose the one in the other, make use of gamboge.

The lake red is done like that of carmine.

The green is done as the lake: always mixing verditer with lily or sap green, to make the shades; which are not very dark.

Several other sorts of draperies may be made at discretion, always taking care to preserve the union of the colours, not only in one sort of cloth or so, but also in a group of several figures; avoiding, as much as the subject will allow, the putting of blue near the colour of fire, of green against black; and so of other colours which cut and disjoin, and whose union is not kind enough.

Several other draperies are made of foul colours, as brown red, bistre, indigo, &c. and all in the same manner. Likewise of other colours, simple and compound; the agreement between which is always to be minded, that the mixture may produce nothing harsh and disagreeable to the eye. No certain rule can be laid down for this. The force and effect of your colours are only to be known from use and experience, and you must work according to that knowledge.

Linen cloths are done thus: After drawing the plaits or folds, as is done in a drapery, put a lay of white over all; then dead colour, and finish the shades with a mixture of ultramarine, black, and white, using more or less of the last, according to their strength or tenderness; and in the greatest deepenings put bistre, mixed with a little white; giving only some touches of this mixture, and even of pure bistre, upon the extremities of the greatest shadows, where the folds must be drawn, and lost with the rest.

They may be done in another manner, by making a general lay of this mixture of ultramarine, black, and very pale white; and dead colour (as has been said before) with the same colour, but a little deeper. And when the shades are dotted and finished, heighten the lights with pure white, and lose them with the deepenings of the linen. But of whatever sort you make them, when they are finished, you must give a yellowish teint of orpiment and white to certain places; laying it lightly on, and as it were in water; so that what is underneath may, notwithstanding, plainly appear, as well the shadows as the dotting.

Yellow linen cloth is done by putting a lay of white, mixed with a little ochre. Then form and finish the shades with bistre, mixed with white and ochre; and in the thickest shades use pure bistre; and before you finish, give some teints here and there of ochre and white, and others of white and ultramarine, as well upon the shades as the lights; but let them be very bright: and drown the whole together in dotting, and it will look finely. As you finish, heighten the extremities of the lights with masticot and white. You may add to this sort of linen, as well as to the white, certain bars from space to space, as in Turkey mantuas; that is, small stripes blue and red with ultramarine and carmine; one of red between two of blue, very bright and clear upon the lights, and deeper upon the shades. Virgins are pretty often dressed with veils of this sort (by Popish painters), and scarfs of this kind are put about necks that are bare; because they become the teint mighty well.

If you would have both these sorts of linen transparent, and the stuff or other thing that is beneath appear through them, make the first lay for them very light and clear, and mix in the colour to shadow with, a little of that which is underneath, especially towards the end of the shades; and only do the extremities of the lights, for the yellow, with masticot and white; and for the white, with pure white.

They may be done in another manner, especially when you would have them altogether as clear as muslin, lawn, or gauze. To this end form and finish what is to be beneath, as if nothing was to be put over it. Then mark out the light and clear folds with white or masticot; and a shadowy with bistre and white, or with black, blue, and white, according to the colour you would make them off; making the rest somewhat fainter: yet this is not necessary but for the parts that are not to be so clear.

Crape is done the same way; excepting that the folds of the shades and the lights, and the borders too, are to be marked out with little filaments of black upon what is underneath; which is likewise to be finished beforehand.

When you would make a stuff like a watered tabby, make the waves upon it with a colour a little lighter, or a little darker, in the lights and the shades.

There is a manner of touching draperies which distinguishes the silken from the woollen. The last are more terrestrial and sensible; the others more light and fading. But it must be observed, that this is an effect which depends partly upon the stuff and partly upon the colour; and for the employing these in a manner suitable to the subjects and the deepenings of painting,

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painting, we shall here touch upon their different qualities.

We have no colour which partakes more of light, nor which comes nearer the air, than white; which shows it to be fickle and fleeting. It may, nevertheless, be held and brought to by some neighbouring colour, more heavy and sensible, or by mixing them together.

Blue is a most fleeting colour: and so we see, that the sky and the remotest views of a picture are of this colour; but it will become lighter and fickler in proportion as it is mixed with white.

Pure black is the heaviest and most terrestrial of all colours; and the more of it you mix with others, the nearer you bring them to the eye.

Nevertheless, the different dispositions of black and white make also their effects different: for white often makes black disappear, and black brings white more into view; as in the reflection of globes, or other figures to be made round, where there are always parts that fly as it were from the eye, and deceive it by the craft of art: and under the white are here comprehended all the light colours; as under the black, all the heavy colours.

Ultramarine is then soft and light.

Ochre is not so much so.

Mastieot is very light; and so is verditer.

Vermilion and carmine come near this quality.

Orpiment and gamboge not so near.

Lake holds a certain mean, rather soft than rough.

Dutch pink is an indifferent colour, easily taking the quality of others. So it is made terrestrial by mixing it with colours that are so; and, on the contrary, the most light and fleeting by joining it with white or blue.

Brown red, umber, dark greens, and bistre, are the heaviest and most terrestrial, next to black.

Skilful painters, who understand perspective, and the harmony of colours, always observe to place the dark and sensible colours on the fore parts of their pictures; and the most light and fleeting they use for the distances and remote views. And as for the union of colours, the different mixtures that may be made of them will learn you the friendship or antipathy they have to one another. And upon this you must take your measures for placing them with such agreement as shall please the eye.

For the doing of lace, French points, or other things of that nature, put over all a lay of blue, black, and white, as for linen; then heighten the flowerwork with pure white: afterwards make the shades above with the first colour, and finish them with the same. When they are upon the carnation or naked parts of a picture, or upon any thing else that you would show through another, finish what is beneath, as if nothing was to be put over it: and at top, make the points or lace with pure white, shadowing and finishing them with the other mixture.

If you would paint a fur, you must begin with a kind of drapery, done, if it be dark, with bistre and white, making the shadowings of the same colour, with less white. If the fur be white, do it with blue, white, and a little bistre. And when this beginning, or first forming, is done, instead of dotting, draw small strokes, turning, now in one manner, now in another, according to the course and flatting of the hair. Heighten the lights of dark furs with ochre and white, and of the other with white and a little blue. Of Carnations.

For doing a building, if it be of stone, take indigo, bistre and white, with which make the beginning or first form of it; and for shadowing it, put less of this last; and more bistre than indigo, according to the colour of the stone you would paint. To these you may likewise add a little ochre, both for the forming and the finishing. But to make it finer, you must give, here and there, especially for old fabrics, blue and yellow teints, some with ochre, others with ultramarine, mixing always white with them, whether before the first forming, provided they appear through the draught, or whether upon it, losing or drowning them with the rest when you finish.

When the building is of wood, as there are many sorts, it is done at discretion; but the most ordinary way is to begin or first form with ochre, bistre, and white, and finish without white, or with very little; and if the shades are deep, with pure bistre. In the other they add sometimes vermilion, sometimes green or black; in a word, just according to the colour they would give it; and they finish with dotting, as in draperies and every thing else.

Sect. V. *Of Carnations, or the naked parts of a Painting.*

There are in carnation so many different colourings, that it would be a difficult thing to give general rules upon so variable a subject. Nor are they minded, when one has got, by custom and practice, some habit of working easily: and such as are arrived to this degree, employ themselves in copying their originals, or else they work upon their ideas, without knowing how: insomuch that the most skilful, who do it with less reflection and pains than others, would likewise be more put to it to give an account of their maxims and knowledge in the matter of painting, if they were to be asked what colours they made use of for such and such a colouring, a teint here, and another there.

Nevertheless, as beginners want some instruction at the first, we will show in general after what manner several carnations are to be done.

In the first place, After having drawn your figure with carmine, and ordered your piece, apply for women and children, and generally for all tender colourings, a lay of white, mixed with a very little of the blue made for faces, of which we have told the composition; but let it hardly be seen.

And for men, instead of blue, they put in this first lay a little vermilion; and when they are old, a little ochre is mixed with it.

Afterwards follow all the traces with vermilion, carmine, and white, mixed together; and begin all the shades with this mixture, adding white in proportion as they are weaker; and putting but little in the darkest, and none, in a manner, in certain places where strong touches are to be given: for instance, in the corner of the eye; under the nose; at the ears; under the chin; in the separations of the fingers; in all joints; at the corners of the nails; and generally in every part where you would mark out separations

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in shades that are obscure. Neither need you fear to give to those places all the force and strength they ought to have as soon as you begin or first form them, because in working at top with green, the red you have put there is always weakened.

After having begun, or first formed, or dead-coloured, with red, make blue teints with ultramarine and a great deal of white, upon the parts which fly from the eye; that is to say, upon the temples; under and in the corners of the eyes; on both sides the mouth, above and below; a little upon the middle of the forehead; between the nose and the eyes; on the side of the cheeks; on the neck and other places where the flesh assumes a bluish cast. Yellowish teints are likewise made with ochre or orpiment, and a little vermilion mixed with white, under the eyebrows, on the sides of the nose towards the bottom, a little underneath the cheeks, and upon the other parts which rise and come nearer the eye. It is especially from these teints that the natural complexion is to be observed, in order to catch it; for painting being an imitation of nature, the perfection of the art consists in the justness and simplicity of the representation, especially in face painting.

When, therefore, you have done your first lay, your dead-colouring, and your teints, you must work upon the shades, dotting with green for the carnations or naked parts, mixing, according to the rule we have given for the teints, a little blue for the parts which fly from the eye; and, on the other hand, making it a little yellower for those that are more sensible; that is to say, which rise, and come nearer the eye: and at the end of the shades, on the side of the light, you must blend and lose your colour insensibly in the ground of the carnation with blue, and then with red, according to the places where you paint. If this mixture of green does not work dark enough at first, pass over the shades several times, now with red, and now with green; always dotting: and this do till they are as they should be.

And if you cannot with these colours give the shades all the force they ought to have, finish, in the darkest, with bistre mixed with orpiment, ochre, or vermilion, and sometimes with pure bistre, according to the colouring you would make, but lightly, laying on your colour very clear.

You must dot upon the clear and bright places with a little vermilion or carmine, mixed with much white, and a very small matter of ochre, in order to lose them with the shadowy, and to make the teints die away insensibly into one another; taking care, as you dot, or hatch, to make your strokes follow the turnings and windings of the fleshy parts. For though the rule be to cross always, this dotting or hatching ought to appear a little more here, because it rounds the parts. And as this mixture might make a colouring too red, if it was always to be used, they work likewise in every part, to blend the teints and the shades with blue and a little green, and much white, so mixed as to be very pale; excepting, nevertheless, that this colour must not be put upon the cheeks, nor upon the extremities of the clear parts, no more than the other mixture upon these last, which must be left with all their light; as certain places of the chin, of the nose, and of the forehead, and upon the cheeks; which, and the cheeks, ought nevertheless to be redder than the rest, as well as the feet, the hollows of the hands, and the fingers of both.

Of Carnation

Observe, that these two last mixtures ought to be so pale, that the work shall hardly be visible; for they serve only to soften it; to unite the teints with one another, and the shades with the lights, and to drown the traces. Care must likewise be taken that you work not too much with the red mixture upon the blue teints, nor with the blue upon the others; but change the colour from time to time, when you perceive it works too blue or too red, till the work be finished.

The white of the eyes must be shadowed with this same blue, and a little flesh colour; and the corners, on the side of the nose, with vermilion and white; giving them a little touch of carmine. The whole is softened with this mixture of vermilion, carmine, white, and a very small matter of ochre.

The apples or balls of the eyes are done with the mixture of ultramarine and white; the last prevailing a little; adding a little bistre, if they are yellowish; or a little black, if they are gray. Make the little black circle in the middle, called the *crystal of the eye;* and shadow the balls with indigo, bistre, or black, according to the colour they are of; giving to each a small touch of pure vermilion round the crystal; which must be lost with the rest at the finishing. This gives vivacity to the eye.

The round or circumference of the eye is done with bistre and carmine; that is to say, the slits or partings, and the eyelids, when they are large and bold; especially the upper ones; which must afterwards be softened with the red or blue mixtures we have mentioned before, to the end they may be lost in one another, and nothing seem intersected. When this is done, give a little touch of pure white upon the crystal, on the side of the lights. This makes the eye shine, and gives life to it.

The mouth is dead coloured with vermilion, mixed with white; and finished with carmine, which is softened as the rest. And when the carmine does not work dark enough, mix a little bistre with it. This is to be understood of the corners in the separation of the lips and particularly, of certain mouths half open.

The hands, and all the other parts of carnation, are done in the same manner as the faces; observing, that the ends of the fingers be a little redder than the rest. When your whole work is formed and dotted, mark the separations of all the parts with little touches of carmine and orpiment mixed together, as well in the shadowy as the light places; but a little deeper and stronger in the first, and lose them in the rest of the carnation.

The eyebrows and the beard are dead-coloured, as are the shades of carnations; and finished with bistre, ochre, or black, according to the colour they are of, drawing them by little strokes the way they ought to go; that is to say, give them all the nature of hair. The lights of them must be heightened with ochre and bistre, a little vermilion, and much white.

For the hair of the head, make a lay of bistre, ochre, and white, and a little vermilion. When it is very dark coloured, use black instead of ochre. Afterwards form the shadowy parts with the same colours, putting

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less white in them; and finish with pure bistre, or mixed with ochre or black, by small strokes very fine, and close to each other, waving and buckling them according to the curling of the hair. The light parts must also be heightened by little strokes with ochre or orpiment, white, and a little vermilion. After which, lose the lights and the shades in each other, by working sometimes with a dark and sometimes with a light colour.

And for the hair about the forehead, through which the skin is seen, it must be first formed with the colour thereof, and that of the carnation, working and shadowing with one and the other, as if you designed to paint none. Then form it, and finish with bistre. The lights are to be heightened as the other. Gray hair is dead-coloured with white, black, and bistre, and finished with the same colour, but deeper; heightening the bright and clear parts of the hair, as well as those of the eyebrows and the beard, with white and very pale blue, after having formed them as the others, with the colour of the flesh or skin; and finish with bistre.

But the most important thing is to soften one's work; to blend the teints in one another, as well as the beard and the hair about the forehead, with the other hair and the carnation; taking especial care not to work rough and dry; and that the traces, turnings, and windings of the carnation or naked parts, be not intersected. You must likewise accustom yourself to put white in your colours only in proportion as you work lighter or darker; for the colour you use the second time must be always a little stronger and deeper than the first, unless it be for softening.

Different colourings are easily made, by putting more or less of red, or blue, or yellow, or bistre, whether for the dead-colouring, or for the finishing.—That for women ought to be bluish; that for children a little red; and both fresh and florid. That for men ought to be yellower; especially when they are old.

To make a colouring of death, there must be a first lay of white and orpiment, or a very pale ochre: dead-colour with vermilion, and lake, instead of carmine, and a good deal of white; and afterwards work over it with a green mixture, in which there is more blue than any other colour, to the end the flesh may be livid and of a purple colour. The tints are done the same way as in another colouring; but there must be a great many more blue than yellow ones, especially upon the parts which fly from the sight, and about the eyes; and the last are only to be upon the parts which rise and come nearer the eye. They are made to die away in one another, according to the ordinary manner; sometimes with very pale blue, and sometimes with ochre and white, and a little vermilion; softening the whole together. The parts and contours must be rounded with the same colours. The mouth is to be, in a manner, of a quite violet. It is dead-coloured, however, with a little vermilion, ochre, and white; but finished with lake and blue; and to give it the deep strokes, they take bistre and lake, with which they likewise do the same to the eyes, the nose, and the ears. If it be a crucifix, or some martyr, upon whom blood is to be seen, after the finishing the carnation, form it with vermilion, and finish it with carmine, making in the drops of blood a little bright reflecting spark, to round them. For the crown of thorns, make a lay of sea-green and masticot; shadow it with bistre and green; and heighten the clear and light parts with masticot.

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Iron is formed, or first laid, with indigo, a little black and white; and finished with pure indigo, heightening it with white.

For painting fire and flames, the lights are done with masticot and orpiment; and for the shades, they mix vermilion and carmine.

A smoke is done with black, indigo, and white, and sometimes with bistre; one may likewise add vermilion or ochre, according to the colour it is to be of.

Pearls are painted by putting a lay of white, and a little blue: they are shadowed and rounded with the same colour, deeper; a small white dot is made almost in the middle on the side of the light; and on the other side, between the shadow and the edge of the pearl, they give a touch with masticot, to make the reflection; and under the pearls is made a little shadow of the colour of the ground they are upon.

Diamonds are made with pure black; then they heighten them with little touches of white on the side of the light. It is the same thing for any other jewels you have a mind to paint: there is nothing to be done but to change the colour.

For making a figure of gold, put a lay of shell-gold, and shadow it with gallstone. Silver is done the same way; excepting that it must be shadowed with indigo.

One great means of acquiring a perfection in the art, is to copy excellent originals. We enjoy with pleasure and tranquillity the labour and pains of others. But a man must copy a great number before he is able to produce as fine effects; and it is better to be a good copier than a bad author.

Sect. VI. *Of Landscapes.*

In the first place, After having ordered the ecouomy of your landscape as of your other pieces, you must form the nearest grounds or lands, when they are to appear dark, with sap or lily-green, bistre, and a little verditer, to give a body to your colour; then dot with this mixture, but a little darker, adding sometimes a little black to it.

For such pieces of ground as the light falls upon, and which are therefore clear and bright, make a lay of ochre and white, then shadow and finish with bistre. In some they mix a little green, particularly for shadowing and finishing.

There are sometimes upon the fore part certain reddish lands; which are dead-coloured with brown-red, white, and a little green; and finished with the same, putting a little more green in them.

For the making of grass and leaves upon the foreground, you must, when that is finished, form with sea-green, or verditer, and a little white: and for those that are yellowish, mix masticot. Afterwards shadow them with lily-green, or bistre and gallstone, if you would have them appear withered.

The grounds or lands at a little distance are formed

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with verditer, and shadowed and finished with sap-green, adding bistre for some of the touches here and there.

Such as are at a greater distance, are done with sea-green and a little blue; and shadowed with verditer.

In a word, the farther they go, the more bluish they are to be made; and the farthest distance ought to be of ultramarine and white; mixing in some places small touches of vermilion.

Water is painted with indigo and white, and shadowed with the same colour, but deeper; and to finish it, instead of dotting, they do nothing but make strokes and traces without crossing; giving them the same turn with the waves, when there are any. Sometimes a little green must be mixed in certain places, and the light and clear parts heightened with pure white, particularly where the water foams.

Rocks are dead-coloured like buildings of stone; excepting that a little green is mixed for forming and shadowing them. Blue and yellow teints are made upon them, and lost with the rest in finishing. And when there are small branches, with leaves, moss, or grass, when all is finished, they are to be raised at top with green and mastieot. They may be made yellow, green, and reddish, for appearing dry in the same manner as on the ground. Rocks are dotted as the rest; and the farther they are off the more grayish they are made.

Castles, old houses, and other buildings of stone and wood, are done in the manner above mentioned; speaking of those things, when they are upon the first lines. But when you would have them appear at a distance, you must mix brown-red and vermilion, with much white; and shadow very tenderly with this mixture; and the farther they are off, the weaker are the strokes to be for the separations. If they are covered with slate, it is to be made bluer than the rest.

Trees are not done till the sky be finished; one may, nevertheless, spare the places of them when they contain a good number; and however it be, such as come near the eye, are to be dead-coloured with verditer, mixing sometimes ochre; and shadowed with the same colours, adding lily-green. Afterwards you must work leaves upon them by dotting without crossing: for this must be done with small longish dots, of a darker colour, and pretty full of it, which must be conducted on the side the branches go, by little tufts of a little darker colour. Then heighten the lights with verditer or sea-green, and mastieot, making leaves in the same manner; and when there are dry branches or leaves, they are dead-coloured with brown-red or gallstone, with white; and finished with gallstone, without white, or with bistre.

The trunks of trees are to be dead-coloured with ochre, white, and a little green, for the light and clear parts; and for the dark they mix black, adding bistre and green for shadowing one and the other.—Blue and yellow tints are likewise made upon them, and little touches given here and there with white and masticot; such as you ordinarily see upon the bark of trees.

The branches which appear among the leaves are done with ochre, verditer, and white; or with bistre and white; according to the light they are placed in. They must be shadowed with bistre and lily-green.

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Trees, which are at a little distance, are dead-coloured with verditer and sea-green; and are shadowed and finished with the same colours, mixed with lily-green. When there are some which appear yellowish, lay with ochre and white, and finish with gallstone.

For such as are in the distances and remote views, you must dead-colour with sea-green; with which, for finishing, you must mix ultramarine. Heighten the lights of one and the other with masticot, by small disjoined leaves.

It is the most difficult part of landscape, in manner of miniature, to leaf a tree well. To learn, and break one's hand to it a little, the way is to copy good ones; for the manner of touching them is singular, and cannot be acquired but by working upon trees themselves; about which you must observe to make little boughs, which must be leafed, especially such as are below and toward the sky.

And generally, let your landscapes be coloured in a handsome manner, and full of nature and truth; for it is that which gives them all their beauty.

Sect. VII. *Of Flowers.*

It is an agreeable thing to paint flowers, not only on account of the splendour of their different colours, but also by reason of the little time and pains that are bestowed in trimming them. There is nothing but delight in it; and, in a manner, no application. You maim and bungle a face, if you make one eye higher than another; a small nose with a large mouth; and so of other parts. But the fears of these disproportions constrain not the mind at all in flower painting; for unless they be very remarkable, they spoil nothing. For this reason, most persons of quality, who divert themselves with painting, keep to flowers. Nevertheless, you must apply yourself to copy justly; and for this part of miniature, as for the rest, we refer you to nature, for she is your best model. Work, then, after natural flowers; and look for the tints and different colours of them upon your pallet: a little use will make you find them easily; and to facilitate this to you at the first, we shall, in the continuance of our design, show the manner of painting some; for natural flowers are not always to be had; and one is often obliged to work after prints, where nothing is seen but graving.

It is a general rule, that flowers are designed and laid like other figures; but the manner of forming and finishing them is different: for they are first formed only by large strokes and traces, which you must turn at the first the way the small ones are to go, with which you finish: this turning aiding much thereto. And for finishing them, instead of hatching or dotting, you draw small strokes very fine, and very close to one another, without crossing; repassing several times, till your dark and your clear parts have all the force you would give them.

Of Roses.—After making your first sketch, draw with carmine the red rose, and apply a very pale lay of carmine and white. Then form the shades with the same colour, putting less white in it: and lastly, with pure

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pure carmine, but very bright and clear at the first; fortifying it more and more as you proceed in your work, and according to the darkness of the shades. This is done by large strokes. Then finish; working upon it with the same colour by little strokes, which you must make go the same way with those of the graving, if it be a print you copy; or the way the leaves of the rose turn, if you copy after a painting, or after nature; losing the dark in the clear parts, and heightening the greatest lights, and the brightest or most lightsome leaves, with white and a little carmine. You must always make the hearts of roses, and the side of the shadow darker than the rest; and mix a little indigo for shadowing the first leaves, particularly when the roses are blown, to make them seem faded. The seed is dead-coloured with gamboge; with which a little sap-green is mixed for shadowing. Roses streaked with several colours, ought to be paler than others, that the mixture of colours may be better seen; which are done with carmine; a little darker in the shades, and very clear in the lights; always hatching by strokes. For white roses you must put a lay of white, and form and finish them as the red; but with black, white, and a little bistre; and make the seed a little yellower. Yellow roses are done by putting in every part a lay of masticot, and shadowing them with gamboge, gallstone, and bistre; heightening the clear and light places with masticot and white.

The stiles, the leaves, and the buds of all sorts of roses are formed with verditer, with which is mixed a little masticot and gamboge; and for shadowing them, they add sap green, putting less of the other colours when the shades are deep. The outside of the leaves ought to be bluer than the inside; wherefore it must be dead-coloured with sea green, and sap green mixed with that for shadowing, making the veins or fibres on this side clearer than the ground, and those on the other side darker. The prickles which are upon the stiles and buds of roses, are done with little touches of carmine, which are made to go every way; and for those that are upon the stalks, they are formed with verditer and carmine, and shadowed with carmine and bistre: making the bottom of the stalks more reddish than the top, i. e. you must mix with the green carmine and pure bistre.

Of Tulips.—As there is an infinity of tulips, different from one another, one cannot pretend to mention the colours with which they are all done. We will only touch upon the handsomest, called *streaked;* and these streaks are dead-coloured with very clear carmine in some places, and with darker in others; finishing with the same colour by little strokes, which must be carried the same way with the streaks. And in others is put first a lay of vermilion. Then they form them by mixing carmine, and finish them with pure carmine. In some they put Florence lake over the vermilion instead of carmine. Some are done with lake and carmine mixed together, and with lake alone, or with white and lake for the first forming; whether it be rosepink or Florence lake. There are some of a purple colour, which are formed with ultramarine, carmine, or lake, sometimes bluer and sometimes redder. The manner of doing both one and the other is the same; there is no difference but in the colours. You must, in certain places, as between the streaks of vermilion, carmine, or lake, sometimes put blue made of ultramarine and white, and sometimes a very bright purple, which is finished by strokes as the rest, and lost with the streaks. There are some likewise that have sallow tints, that are made with lake, bistre, and ochre, according as they are: but this is only in fine and rare tulips, and not in the common ones. For shadowing the bottom of them, they ordinarily take indigo and white for such whose streaks are of carmine. For such as are of lake, they take black and white; with which, in some, bistre is mixed, and in others green. Some are likewise to be shadowed with gamboge and umber, and always by strokes and traces, that turn as the leaves turn. Other tulips are likewise done, called *bordered;* that is to say, the tulip is not streaked but on the edges of the leaves, where there is a border. It is white in the purple; red in the yellow; yellow in the red; and red in the white. The purple is laid with ultramarine, carmine, and white; shadowing and finishing it with this mixture. The border is spared; that is to say, let only a light lay of white be put there, and let it be shadowed with very bright indigo. The yellow is formed with gamboge, and shadowed with the same colour, mixing ochre and umber or bistre with it. The border is laid with vermilion, and finished with a very small matter of carmine. The red is formed with vermilion, and finished with the same colour, mixing carmine or lake with it. The bottom and the border are done with gamboge; and for finishing, they add gallstone and umber, or bistre. The white is shadowed with black, blue, and white. Indian ink is very proper for this. The shadowings of it are very tender. It produces alone the effect of blue and white, mixed with the other black. The border of this white tulip is done with carmine. In all these sorts of tulips, they leave a nerve or sinew in the middle of the leaves that are brighter than the rest; and the borders are drowned at the bottom by small traces, turning crosswise; for they must not appear cut and separated, as the streaked or party-coloured. They make them likewise of several other colours. When they happen to be such whose bottoms on the inside are black, as it were, they form and finish them with indigo, as also the seed about the nozzle or stalk. And if the bottom is yellow, it is formed with gamboge, and finished by adding umber or bistre. The leaves and the stalks of tulips are ordinarily formed with sea green, and shadowed and finished with lily green, by large traces all along the leaves. Some may likewise be done with verditer, mixing masticot with it, and shadowed with sap green, that the green of the shades may be yellower.

The Anemony, or *Wind-flower.*—There are several sorts of them, as well double as single. The last are ordinarily without streaks. Some are made of a purple colour, with purple and white, shadowing them with the same colour; some redder, others bluer; sometimes very pale, and sometimes very dark. Others are formed with lake and white, and finished with the same, putting less white; some without any white at all. Others are formed with vermilion, and shadowed with the same colour; adding carmine. We see likewise white ones, and some of a citron colour. The last are laid with masticot; and one and the other

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shadowed and finished sometimes with vermilion, and sometimes with very brown lake, especially near the seed, at the bottom; which is often likewise of a blackish colour, that is done with indigo, or black and blue, mixing for some a little bistre; and always working by very fine strokes and traces, and losing the lights in the shades. There are others that are brighter and clearer at the bottom than anywhere else; and sometimes they are perfectly white there, though the rest of the flower be dark. The seed of all these anemonies is done with indigo and black, with a very little white, and shadowed with indigo; and in some it is raised with masticot. The double anemonies are of several colours. The handsomest have their large leaves streaked. Some are done, that is, the streaked or party coloured, with vermilion, to which carmine is added for the finishing; shadowing the rest of the leaves with indigo; and for the small leaves within, a lay is put of vermilion and white, and they are shadowed with vermilion mixed with carmine, mixing here and there some stronger touches, especially in the heart of the flower, next the great leaves on the side of the shadow. They finish with carmine, by little strokes and traces, turning the same way with the mixed or party colours, and the leaves. They form and finish the streaks or party colours of some others, as well as the small leaves, with pure carmine; leaving, nevertheless, in the middle of the last, a little circle, in which is laid dark purple, which is lost with the rest. And when all is finished, they give some touches with this same colour round about the small leaves, especially on the side of the shadow, drowning them with the large ones, the remainder of which is shadowed either with indigo or black. In some, the small leaves are done with lake or purple, though the party colours of the large ones be done with carmine. There are others, whose mixed colours are done with carmine, in the middle of most of the large leaves; putting in some places vermilion underneath, and losing these colours with the shadows of the bottom; which are done with indigo and white. The small leaves are laid with masticot, and shadowed with very dark carmine on the side of the shade, and with very clear on the side of the light, leaving there in a manner pure masticot, and giving only some little touches with orpiment and carmine, to separate the leaves, which may be shadowed sometimes with a very little pale green. There are double anemonies painted all red, and all purple. The first are formed with vermilion and carmine, in a manner without white, and shadowed with pure carmine, well gummed, that they may be very dark. Purple anemonies are laid with purple, and white, and finished with white. In a word, there are double anemonies as there are single ones, of all colours; and they are done in the same manner. The green of one and the other is verditer; with which masticot is mixed for forming. It is shadowed and finished with sap green. The stiles of them are a little reddish; wherefore they are shadowed with carmine mixed with bistre, and sometimes with green, after having laid them with masticot.

The CARNATION and the PINK.—It is with pinks and carnations as with anemonies and tulips; that is, there are some mixt-coloured, and others of one single colour. The first are streaked and diversified sometimes with vermilion and carmine; sometimes with pure lake, or with white; some streaks very dark, and others very pale; sometimes by little streaks and diversifications, and sometimes by large ones. Their bottoms are ordinarily shadowed with indigo and white. There are pinks of a very pale flesh colour, and streaked and diversified with another, a little deeper, made with vermilion and lake. Others, which are of lake and white, are shadowed and streaked without white. Others all red, which are done with vermilion and carmine as dark as possible. Others all of lake. And, lastly, there are others, wherein nature or fancy is the rule. The green of one and the other is sea green, shadowed with lily green or sap green.

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The RED LILY.—It is laid with red lead, formed with vermilion, and in the deepest of the shades with carmine; and finished with the same colour by strokes and traces, turning as the leaves turn. The clear and light parts are heightened with red lead and white. The seed is done with vermilion and carmine. The green parts are done with verditer, shadowed with lily or sap green.

The DAY LILY.—There are three sorts of them:

1. The gridelin, a little red;
2. The gridelin, very pale; and,
3. The white.

For the first they put a lay of lake and white, and shadow and finish with the same colour deeper; mixing a little black to deaden it, especially in the darkest places.

The second are laid with white, mixed with a very little lake and vermilion, in such a manner that these two last colours are hardly seen. Afterwards they shadow with black and a little lake, working redder in the middle of the leaves, next the stalks; which ought to be, as also the seed, of the same colour, particularly towards the top; and at the bottom a little greener.

The stile of the seed is laid with masticot, and shadowed with sap green.

The other day lilies are done by putting a lay of pure white, and shadowing and finishing with black and white.

The stalks of these last, and the greens of them all, are done with sea green, and shadowed with sap green.

The HYACINTH, or *Purple-flower*.—There are four sorts of them:

The blue, a little dark;
Others paler;
The gridelin;
And the white.

The first are laid with ultramarine and white; and shadowed and finished with less white. Others are laid and shadowed with pale blue. The gridelines are formed with lake and white, and a very small matter of ultramarine; and finished with the same colour a little deeper. For the last they put a lay of white; then they shadow them with black, with a little white; and finish them all by strokes and traces, following the turnings and windings of the leaves. The green and the stalks of such as are blue, are done with sea and lily green very dark: and in the stalks of the first may be mixed a little carmine, to make them reddish. The stalks of the two others, as also the green, are

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are formed with verditer and masticot, and shadowed with sap green.

The Piony.—A lay of Venice lake and white must be put on all parts, pretty strong: then shadow with less white, and with none at all in the darkest places: after which finish with the same colour by traces, turning them as for the rose; gumming it very much in the deepest of the shades; and raising the lights and the edges of the most lightsome leaves with white and a little lake. Little veins are likewise made, which go like the strokes in hatching, but are more visible. The green of this flower is done with sea green, and shadowed with sap green.

Cowslips.—They are of four or five colours. There are some of a very pale purple.

The gridelin. The white and the yellow.

The purple is done with ultramarine, carmine, and white; putting less white for shadowing. The gridelin is laid with Venice lake, and a very small matter of ultramarine, with much white; and shadowed with the same colour deeper. For the white a lay of white must be put; and they must be shadowed with black and white; and finished, as the others, by traces or strokes. The heart of these cowslips is done with masticot in the shape of a star, which is shadowed with gamboge, making a little circle in the middle with sap green. The yellow are laid with masticot, and shadowed with gamboge and umber. The stiles, the leaves, and the buds, are formed with verditer, mixed with a little masticot, and finished with sap green; making the fibres or veins, which appear upon the leaves, with this same colour; and heightening the lights of the largest with masticot.

The Ranunculus, or *Crow-foot*.—There are several sorts of them: the finest are the orange-coloured. For the first, they put a lay of vermilion, with a very small matter of gamboge; and add carmine for shadowing; finishing it with this last colour, and a little gallstone. In the others may be put Venice lake instead of carmine, especially in the heart of the flower. The orange-coloured are laid with gamboge, and finished with gallstone, vermilion, and a little carmine; leaving some little yellow streaks. The green of the stalks is done with verditer and very pale masticot; mixing lily green to shadow them. That of the leaves is a little darker.

The Crocus.—These are of two colours:

Yellow and purple. The yellow are formed with masticot and gallstone, and shadowed with gamboge and gallstone: after which, upon each leaf, on the outside, are made three streaks, separate from one another, with bistre and pure lake; which are lost, by little traces, in the bottom. The outside of the leaves is left all yellow.—The purple is laid with carmine, mixed with a little ultramarine, and very pale white. They are formed and finished with less white; making likewise, in some, purple stripes or streaks, very dark, as in the yellow; and in others only small veins. The seed of both is yellow, and is done with orpiment and gallstone. For the stiles, they put a lay of white, and shadow with black, mixed with a little green. The green of this flower is formed with very pale verditer, and shadowed with sap-green.

The Iris.—The Persian iris is done by putting, for the inside leaves, a lay of white, and shadowing them with indigo and green together, leaving a little white separation in the middle of each leaf; and for those on the outside, they put in the same place a lay of masticot, which is shadowed with gallstone and orpiment; making little dark and longish dots over all the leaf, at a small distance from one another. And at the end of each are made large stains, with bistre and lake in some, and in others with pure indigo, but very black. The rest, and the outside of the leaves, are shadowed with black. The green is formed with sea green, and very pale masticot, and shadowed with sap green. The Susian iris is laid with purple and white, putting a little more carmine than ultramarine; and for the shades, especially in the middle leaves, they put less white; and, on the contrary, more ultramarine than carmine; making the veins of this very colour, and leaving in the middle of the inside leaves a little yellow sinew. There are others which have this very sinew in the first leaves; the end of which only is bluer than the rest. Others are shadowed and finished with the same purple, redder: They have also the middle sinew on the outside leaves; but white and shadowed with indigo. There are likewise yellow ones; which are done by putting a lay of masticot and orpiment; shadowing them with gallstone, and making the veins upon the leaves with bistre. The green of one and the other is done with sea green, mixing a little masticot for the stiles. They are shadowed with sap green.

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The Jasmine.—It is done with a lay of white, and shadowed with black and white; and for the outside of the leaves, they mix a little bistre; making the half of each, on this side, a little reddish with carmine.

The Tuberose.—For the doing of this, they make a lay of white, and shadow with black, with a little bistre in some places; and for the outside of the leaves they mix a little carmine, to give them a reddish teint, particularly upon the extremities. The seed is done with masticot, and shadowed with sap green. The green of it is laid with verditer, and shadowed with sap green.

The Hellebore.—The flower of hellebore is done almost in the same manner; that is, let it be laid with white, and shadowed with black and bistre, making the outside of the leaves a little reddish here and there. The seed is laid with dark green, and raised with masticot. The green of it is foul and rusty, and is formed with verditer, masticot, and bistre; and finished with sap green and bistre.

The White Lily.—It is laid with white, and shadowed with black and white. The seed is done with orpiment and gallstone. And the green is done as in the tuberose.

The Snow-drop.—It is formed and finished as the white lily. The seed is laid with masticot, and shadowed with gallstone. And the green is done with sea and sap green.

The Jonquil.—It is laid with masticot and gallstone, and finished with gamboge and gallstone. The green is formed with sea green, and shadowed with sap green.

The Daffodil.—All daffodils, the yellow, the double, and the single, are done by putting a lay of masticot: they are formed with gamboge, and finished by adding umber and bistre; excepting the bell in the middle, which is done with orpiment and gallstone, bordered

Of Flowers.

bordered or edged with vermilion and carmine. The white are laid with white, and shadowed with black and white; excepting the cup or bell, which is done with masticot and gamboge. The green is sea green, shadowed with sap green.

The MARIGOLD.—It is done by putting a lay of masticot, and then one of gamboge; shadowing it with this very colour, after vermilion is mixed with it: and for finishing, they add gallstone and a little carmine. The green is done with verditer, shadowed with sap green.

The AUSTRIAN ROSE.—For making the Austrian rose, they put a lay of masticot, and another of gamboge. Then they form it, mixing gallstone; and finish it with the last colour, adding bistre and a very small matter of carmine in the deepest shades.

The INDIAN PINK, or *French Marigold*.—It is done by putting a lay of gamboge; shadowing it with this colour, after you have mixed a good deal of carmine and gallstone with it; and leaving about the leaves a little yellow border of gamboge, very clear in the lights, and darker in the shades. The seed is shadowed with bistre. The green, as well of the rose as the pink, is formed with verditer, and finished with sap-green.

The SUN-FLOWER.—It is formed with masticot and gamboge, and finished with gallstone and bistre. The green is laid with verditer and masticot, and shadowed with sap green.

The PASSION FLOWER.—It is done as the rose, and the green of the leaves likewise; but the veins are done with a darker green.

POETICAL PINKS and SWEET WILLIAM.—They are done by putting a lay of lake and white; shadowing them with pure lake, with a little carmine for the last; which are afterwards dotted on all parts with little round dots, separate from one another; and the threads in the middle are raised with white. The green of them is sea green, which is finished with sap green.

The SCABIOUS.—There are two sorts of scabious, the red and the purple. The leaves of the first are laid with Florentine lake in which there is a little white; and shadowed without white; and for the middle, which is a great boss or husk in which the seed lies, it is formed and finished with pure lake, with a little ultramarine or indigo to make it darker. Then they make little white longish dots over it, at a pretty distance from one another, clearer in the light than in the shade, making them go every way. The other is done by putting a lay of very pale purple, as well upon the leaves as the boss in the middle; shadowing both with the same colour, a little deeper: and instead of little white touches for the seed, they make them purple; and about each grain they make out a little circle, and this over the whole boss or husk in the middle. The green is formed with verditer and masticot, and shadowed with sap green.

The SWORD or *Day Lily*.—It is laid with Florence lake and very pale white; formed and finished with pure lake, very clear and bright in some places, and very dark in others; mixing even bistre in the thickest of the shades. The green is verditer, shadowed with sap green.

HEPATICA, or *Liverwort*.—There is red and blue. The last is done by putting on all parts a lay of ultramarine, white, and a little carmine or lake: shadowing the inside of the leaves with the mixture, but deeper; excepting those of the first rank; for which, and for the outside of every one of them, they add indigo and white, that the colour may be paler, and not so fine. The red is laid with lake columbine and very pale white; and finished with less white. The green is done with verditer, masticot, and a little bistre; and shadowed with sap green, and a little bistre, especially on the outside of the leaves.

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The POMEGRANATE.—The flower of the pomegranate is laid with red lead; shadowed with vermilion and carmine; and finished with this last colour. The green is laid with verditer and masticot, and shadowed with sap green.

The flower of the Indian BEAN.—It is done with a lay of Levant lake and white; shadowing the middle leaves with pure lake; and adding a little ultramarine for the others. The green is verditer, shadowed with sap green.

The COLUMBINE.—There are columbines of several colours: the most common are the purple, the gridelin, and the red. For the purple, they lay with ultramarine, carmine, and white; and shadow with this mixture deeper. The gridelin are done the same way, putting a great deal less ultramarine than carmine. The red are done with lake and white, finishing with less white. There are some mixed flowers of this kind, of several colours; which must be formed and finished as the others, but paler, making the mixtures of a little darker colour.

The LARK'S HEEL.—These are of different colours, and of mixed colours: the most common are the purple, the gridelin, and the red; which are done as the columbines.

VIOLETS and PANSIES.—Violets and pansies are done the same way; excepting that in the last the two middle leaves are bluer than the others; that is, the borders or edges; for the inside of them is yellow: and there little back veins are made, which take their beginning from the heart of the flower, and die away towards the middle.

The MUSCIPULA, or *Catch-fly*.—There are two sorts of it, the white and the red; the last is laid with lake and white, with a little vermilion, and finished with pure lake. As for the knot or nozzle of the leaves, it is formed with white and a very small matter of vermilion, mixing bistre or gallstone to finish it. The leaves of the white are laid with white; adding bistre and masticot upon the knots which are shadowed with pure bistre, and the leaves with black and white. The green of all these flowers is done with verditer and masticot, and shadowed with sap green.

The CROWN IMPERIAL,—which is of two colours, the yellow and the red. The first is done by putting a lay of orpiment, and shadowing it with gallstone and orpiment with a little vermilion. The other is laid with orpiment and vermilion, and shadowed with gallstone and vermilion; making the beginning of the leaves next the stile, with lake and bistre, very dark; and veins with this mixture both in one and the other, all along the leaves. The green is done with verditer and masticot, shadowed with sap green and gamboge.

The CYCLAMEN, or *Sowbread*.—The red is laid with

Of Flowers.

with earmine, a little ultramarine, and much white; and finished with the same colour, deeper; putting, in a manner, only earmine in the middle of the leaves, next the heart, and in the rest add a little more ultramarine. The other is laid with white, and shadowed with black. The stalks of one and the other ought to be a little reddish; and the green, verditer and sap green.

The GILLIFLOWER.—There are several sorts of gilliflowers; the white, the yellow, the purple, the red, and the mixed of various colours. The white are laid with white, and shadowed with black, and with a little indigo in the heart of the leaves. The yellow, with masticot, gamboge, and gallstone. The purple are formed with purple and white; and finished with less white; making the colour brighter in the heart, and even a little yellowish. The red with lake and white; finishing them with white. The mixed coloured are laid with white, and the mixtures are sometimes made with purple, in which there is much ultramarine; others again, in which there is more earmine. Sometimes they are of lake, and sometimes of earmine. Some are done with white, and others without white; shadowing the rest of the leaves with indigo. The seed of all is formed with verditer and mastieot, and finished with sap green. The leaves and stiles are laid with the same green, mixing sap green to finish them.

FRUITS, fishes, serpents, and all sorts of reptiles, are to be touched in the same manner as the figures of men are; that is, hatched or dotted.

Birds and all other animals are done like flowers, by strokes or traces.

Never make use, for any of these things, of white lead. It is only proper in oil. It blackens like ink when only tempered with gum; especially if you set your work in a moist place, or where perfumes are. Ceruss of Venice is as fine, and of as pure a white. Be not sparing in the use of this, especially in forming or dead-colouring; and let it enter into all your mixtures, in order to give them a certain body, which will render your work gluish, and make it appear soft, plump, and strong. Of Flowers.

The taste of painters is, nevertheless, different in this point. Some use a little of it, and others none at all. But the manner of the last is meagre and dry. Others use a great deal; and doubtless it is the best method, and most followed among skilful persons; for besides that it is speedy, one may by the use of it copy all sorts of pictures; which would be almost impossible otherwise; notwithstanding the contrary opinion of some, who say, that in miniature we cannot give the force and all the different teints we see in pieces in oil. But this is not true, at least of good painters; and effects prove it pretty plainly: for we see figures, landscapes, pictures, and every thing else in miniature, touched in as grand, as true, and as noble a manner (though more tender and delicate), as they are in oil.

However, painting in oil has its advantages; were they only these, that it exhibits more work, and takes up less time. It is better defended likewise against the injuries of time; and the right of birth must be granted it, and the glory of antiquity.

But miniature likewise has its advantages; and without repeating such as have been mentioned already, it is neater and more commodious. You may easily carry all your implements in your pockets, and work when and wherever you please, without such a number of preparations. You may quit and resume it when and as often as you will; which is not done in the other; in which one is rarely to work dry.

To conclude: In the art of painting, excellence does not depend upon the greatness of the subject, but upon the manner in which it is handled. Some catch the airs of a face well; others succeed better in landscapes: some work in little, who cannot do it in large: some are skilled in colours, who know little of design: others, lastly, have only a genius for flowers: and even the Bassans got themselves a fame for animals; which they touched in a very fine manner, and better than any thing else.

M I N

Minim || Minister.

MINIM, in *Music*, a note equal to two crotchets, or half a semibreve. See MUSIC.

MINIMS, a religious order in the church of Rome, founded by St Francis de Paula, towards the end of the 15th century. Their habit is a coarse black woollen stuff, with a woollen girdle, of the same colour, tied in five knots. They are not permitted to quit their habit and girdle night nor day. Formerly they went barefooted, but are now allowed the use of shoes.

MINIMUM, in the higher geometry, the least quantity attainable in a given case.

MINISTER, a person who preaches, performs religious worship in public, administers the sacraments, &c.

MINISTER of State, a person to whom the prince intrusts the administration of government. See COUNCIL.

M I N

Minister || Minnin.

Foreign MINISTER, is a person sent into a foreign country, to manage the affairs of his province or of the state to which he belongs. Of these there are two kinds: those of the first rank are ambassadors and envoys extraordinary, who represent the persons of their sovereigns; the ministers of the second rank are the ordinary residents.

MINIUM, or RED-LEAD. See CHEMISTRY *Index*.

MINNIN, a stringed instrument of music among the ancient Hebrews, having three or four chords to it, although there is reason to question the antiquity of this instrument; both because it requires a hair bow, which was a kind of plectrum not known to the ancients, and because it so much resembles the modern viol. Kircher took the figures of this, the machul, chinnor, and psaltery, from an old book in the Vatican library.

MINOR,

Minor, Minorca.

MINOR, a Latin term, literally denoting *less*; used in opposition to *major*, greater.

MINOR, in *Law*, denotes a person under age; or who, by the laws of the country, is not yet arrived at the power of administering his own affairs, or the posession of his estate. Among us, a person is a minor till the age of twenty-one, before which time his acts are invalid. See AGE, and INFANT.

It is a maxim in the common law, that in the king there is no minority, and therefore he hath no legal guardian; and his royal grants and assents to acts of parliament are good, though he has not in his natural capacity attained the legal age of twenty-one. It is also provided by the custom and law of parliament, that no one shall sit or vote in either house unless he be twenty-one years of age. This is likewise expressly declared by stat. 7 and 8 Will. III. cap. 25. with regard to the house of commons.

MINOR in *Logic*, is the second proposition of a formal or regular syllogism, called also the *assumption*.

MINOR, in *Music*, is applied to certain concords, which differ from or are lower than others of the same denomination by a lesser semitone or four commas.—Thus we say, a third minor, or lesser third, or a sixth major and minor. Concords that admit of major and minor, i. e. greater and less, are said to be imperfect concords.

MINORCA, an island of the Mediterranean, situated between 39 and 40 degrees of north latitude, and near four degrees of east longitude. It is about 33 miles in length from north-west to south-east, in breadth from eight to twelve, but in general about ten miles; so that in size it may nearly equal the county of Huntingdon or Bedfordshire. The form is very irregular; and the coasts are much indented by the sea, which forms a great number of little creeks and inlets, some of which might be very advantageous.

This island is one of those called by the ancient Romans *Baleares*, which arose from the dexterity of the inhabitants in using the sling. It fell under the power of the Romans, and afterwards of the northern barbarians. From them it was taken by the Arabs; who were subdued by the king of Majorca, and he by the king of Spain. The English subdued it in 1708; it was afterwards retaken by the French in 1756, but restored to Britain by the treaty of Paris in 1763. The Spaniards took it in 1782; the British regained it in 1798; but it was given up in 1802, and continues in the possession of Spain.

The air of this island is much more clear and pure than in Britain; being seldom darkened with thick fogs; yet the low valleys are not free from mists and unwholesome vapours; and in windy weather the spray of the sea is driven over the whole island. Hence it happens that utensils of brass or iron are extremely suseeptible of rust, in spite of all endeavours to preserve them; and household furniture becomes mouldy. The summers are dry, clear, calm, and excessively hot; the autumns moist, warm, and unequal; at one time perfectly serene, at another cloudy and tempestuous. During the winter there are sometimes violent storms, though neither frequent nor of long continuance; and whenever they cease, the weather returns to its usual serenity. The spring is always variable, but resembles the winter more than the summer. The changes of heat and cold are neither so great nor so sudden in this climate as in many others. In the compass of a year, the thermometer seldom rises much above the 80th, or falls below the 48th degree. In summer there is scarcely ever a difference of four or five degrees between the heat of the air at noon and at night; and in winter the variation is still less considerable. But this must be understood of a thermometer shaded from the influence of the solar beams: for if exposed to them it will often rise 12, 14, or 16 degrees higher than what we have mentioned; and in other seasons the difference between the heat of the air in the sun and the shade is much greater. Yet even in the dog-days, the heat of the atmosphere, at least in open places, seldom surpasses that of human blood. The winds are very boisterous about the equinoxes, and sometimes during the winter. At other times they are generally moderate, and, according to the observations of seamen, they rarely blow in the same direction near the islands adjacent to the gulf of Lyons as in the open sea. During the summer there is commonly a perfect calm in the mornings and evenings; but the middle of the day is cooled by refreshing breezes which come from the east, and following the course of the sun, increase gradually till two or three in the afternoon, after which they insensibly die away as night approaches. This renders the heat of the sun less dangerous and inconvenient; and if these breezes intermit for a day or two, the natives grow languid and inactive from the heat. The northerly winds in general are clear and healthy, dispel the mists, and make a clear blue sky; whilst those which blow from the opposite quarter, render the air warm, moist, and unhealthy. The north wind is superior in power to all the rest; which appears from hence, that the tops of all the trees incline to the south, and the branches on the north side are bare and blasted. The next to it in force is the north-west. Both are frequent towards the close of winter and in the spring; and, being dry and cold, they shrivel up the leaves of the vegetables, destroy their tender shoots, and are often excessively detrimental to the vineyards and rising corn. The piercing blasts at that season from the north-east, as they are more moist, and more frequently attended with rain, are less prejudicial. The south and south-east winds are by much the most unhealthy. In whatever seasons they blow, the air is foggy, and affects the breathing; but in the summer season they are sultry and suffocating. An excessive dejection of spirits is then a universal complaint; and on exposing the thermometer to the rays of the sun, the mercury has frequently risen above the 100th degree. The west wind is usually drier than the south: the east is cold and blustering in the spring, and sultry in the summer.

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The weather in Minorca is generally fair and dry; but when it rains, the showers are heavy, though of short continuance, and they fall most commonly in the night. The sky in summer is clear, and of a beautiful azure, without clouds or rain; but moderate dews descend regularly after sunset. In autumn the weather becomes less serene; whirlwinds and thunder become frequent; and in the night time lightning, and those meteors called *falling stars*, are very common. Water spouts also are often seen at that season, and frequently break upon the shore. A sudden alteration in the weather takes place about the autumnal equinox; the skies

are

Minorca. are darkened with clouds, and the rains fall in such quantities, that the torrents thereby occasioned, pouring down from the hills, tear up trees by the root, carry away cattle, break down fences, and do considerable mischief to the gardens and vineyards. But these anniversary rains are much more violent than lasting; always falling in sudden and heavy showers, with intervals of fair weather. They are accompanied with thunder, lightning, and squalls of wind, most commonly from the north. Hail and snow are often intermixed with the rains which fall in winter and in spring; but the snow, for the most part, dissolves immediately; and ice is here an uncommon appearance.

The whole coast of Minorca lies low; and there are only a few hills near the centre, of which the most considerable, named *Toro* by the inhabitants, may be seen at the distance of 12 or 14 leagues from the land. The surface of the island is rough and unequal; and in many places divided by long narrow vales of a considerable depth, called *barancoes* by the natives. They begin towards the middle of the island, and after several windings terminate at the sea. The south west side is more plain and regular than towards the north-east; where the hills are higher, with low marshy valleys betwixt them, the soil less fruitful, and the whole tract unhealthy to man and beast. Near the towns and villages the fields are well cultivated, and enclosed with stone walls; but the rest for the most part are rocky, or covered with woods and thickets. There are some pools of standing water, but very few rivulets, which is the greatest defect about the island, as the inhabitants have scarcely any wholesome water excepting what is saved from the clouds.

The soil is light, thin, and very stony, with a good deal of sea salt, and, in some places, of calcareous nitre intermixed. In most places there is so little earth, that the island appears to be but one large irregular rock, covered here and there with mould, and an infinite variety of stones. Notwithstanding this, however, it is not only extremely proper for vineyards, but produces more wheat and barley than could at first sight be imagined; and if the peasants may be credited, it would always yield a quantity of corn and wine sufficient for the natives, did not the violence of the winds, and the excessive drought of the weather, frequently spoil their crops. The fields commonly lie fallow for two years, and are sown the third. About the latter end of winter, or the beginning of spring, they are first broke up: and next autumn, as soon as the rains fall, they are again ploughed and prepared for receiving the proper seeds. The tillage is very easily performed; for a plough so light as to be transported from place to place on the ploughman's shoulder, and to be drawn by a heifer, or an ass sometimes assisted by an hog, is sufficient for opening so thin a soil. The later the harvest happens, the more plentiful it proves. The barley is usually cut down about the 20th of May and the wheat is reaped in June, so that the whole harvest is commonly got in by Midsummer day. The grain is not thrashed with flails as in this country, but trodden out on a smooth piece of rock by oxen and asses, according to the custom of the eastern nations.

The natives of Minorca are commonly lean, thin, and well-built, of a middle stature, and olive complexion; but their character is by no means agreeable. Such is the natural impetuosity of their temper, that the slightest cause provokes them to anger, and they seem to be incapable of forgiving or forgetting any injury. Hence quarrels break out daily, even among neighbours and relations: and family disputes are transmitted from father to son; and thus, though lawyers and pettifoggers are very numerous in this country, there are still too few for the clients. Both sexes are, by constitution, extremely amorous: they are often betrothed to each other while children, and marry at the age of 14. The women have easy labours, and commonly return in a few days to their usual domestic business; but, lest the family should become too numerous for their income, it is a practice among the poorer sort to keep their children at the breast for two or three years, that by this means the mothers may be hindered from breeding. Minorca.

Bread of the finest wheat flour, well fermented and well baked, is more than half the diet of people of all ranks. Rice, pulse, vermicelli, herbs and roots from the garden, summer fruits, pickled olives and pods of the Guinea pepper, make up almost all the other half, so that scarce a fifth of their whole food is furnished from the animal kingdom, and of this fish makes by much the most considerable portion. On Fridays, and other fast days, they abstain entirely from flesh; and during Lent they live altogether on vegetables and fish, excepting Sundays, when they are permitted the use of eggs, cheese, and milk. Most of their dishes are high-seasoned with pepper, cloves, cinnamon, and other spices; and garlic, onions, or leeks, are almost constant ingredients. They eat a great deal of oil, and that none of the sweetest or best flavoured; using it not only with salads, but also with boiled and fried fish, greens, pulse, &c. instead of butter. A slice of bread soaked in boiled water, with a little oil and salt, is the common breakfast of the peasants, well known by the name of *oleagua*. Their ordinary meals are very frugal, and consist of very little variety; but on festivals and other solemn occasions their entertainments are to the last degree profuse and extravagant, insomuch that the bill of fare of a country farmer's wedding dinner would scarce be credited.

With regard to other matters, the Minorquins are accused of prodigious indolence in the way of business, and neglect of the natural advantages they possess. In the bowels of the earth are iron, copper, and lead ores, of none of which any use has been made except the last. A lead mine was worked to advantage some time ago, and the ore sent into France and Spain for the use of the potteries in those countries. The proprietor discontinued his work on some small discouragement; and indeed it is said, that these people are of all mankind the most easily put out of conceit with an undertaking that does not bring them in mountains of present gain, or that admits of the slightest probability of disappointing their most sanguine expectations: nor will their purse admit of many disappointments; and thus their poverty co-operating with their natural despondence and love of ease, is the principal cause of their backwardness to engage in projects, though ever so promising for the improvement of their private fortune, and the advantage of the commerce of their

Minorca. country. This lead ore went under the name of *vernis* among the natives; as it was wholly used by the potters in varnishing and glazing their earthen vessels.

There are few exports of any account, and they are obliged to their neighbours for near one-third of their corn, all their oil, and such a variety of articles of less consideration, that nothing could preserve them from a total bankruptcy, but the English money circulated by the troops, which is exchanged for the daily supplies of provisions, increased by the multiplication of vineyards, the breeding of poultry, and the production of vegetables, in a proportion of at least five to one since the island has been in our possession. It will not require many words to enumerate their exports: they make a sort of cheese, little liked by the English, which sells in Italy at a very great price; this, perhaps, to the amount of 800l. *per annum*.—The wool they send abroad may produce 900l. more.—Some wine is exported; and, if we add to its value that of the home consumption, which has every merit of an export, being nine parts in ten taken off by the troops for ready money, it may well be estimated at 16,000l. a-year. In honey, wax, and salt, their yearly exports may be about 400l. and this comes pretty near the sum of their exports, which we estimate together at 18,100l. sterling *per annum*.

A vast balance lies against them, if we consider the variety and importance of the articles they fetch from other countries, for which they must pay ready cash. Here it may be necessary to withdraw some things from the heap, such as their cattle, sheep, and fowls, on which they get a profit; for the country does not produce them in a sufficient abundance to supply them, especially when we have a fleet of men of war stationed there.

Their imports are, corn, cattle, sheep, fowls, tobacco, oil, rice, sugar, spices, hardware, and tools of all kinds; gold and silver lace; chocolate, or cocoa to make it; tobacco, timber, plank, boards, millstones, tobacco pipes, playing cards, turnery ware, seeds, soap, saddles; all manner of cabinetmakers work, iron spikes, nails, fine earthen ware, glass lamps, brasiery; paper, and other stationary wares; copperas, galls, dye stuffs, painters brushes and colours; musical instruments, music, and strings; watches, wine, fruit, all manner of fine and printed linens, muslins, cambrics, and laces; bottles, corks, starch, indigo, fans, trinkets, toys, ribbands, tape, needles, pins, silk, mohair, lanthorns, cordage, tar, pitch, rosin, drugs, gloves, fire-arms, gunpowder, shot, and lead; hats, caps, velvet, cotton stuffs, woollen cloths, stockings, capes, medals, vestments, lustres, pictures, images, agnus dei's, books, pardons, bulls, relicks, and indulgencies.

The island is divided into what they style *terminos*, of which there were anciently five, now reduced to four, and resemble our counties. The termino of Ciudadella, at the north-western extremity of the island, is so styled from this place, which was once a city, and the capital of Minorca. It makes a venerable and majestic figure, even in its present state of decay, having in it a large Gothic cathedral, some other churches and convents, the governor's palace, and an exchange, which is no contemptible pile.—There are in it 600 houses, which, before the seat of government and the courts of justice were removed to Mahon, were fully inhabited; and there are still more gentlemen's families here than in all the rest of the island. It hath a port commodious enough for the vessels employed in the trade of this country, which, though in the possession of a maritime power, is less than it formerly was. It is still, in the style of our officers, *the best quarters* (and there are none bad) in the country; and if there was a civil government, and the place made a free port, the best judges are of opinion it would very soon become a flourishing place again; and the fortifications, if it should be found necessary, might then also be easily restored and improved. Minorca

The termino of Ferrerias is the next, a narrow slip reaching cross from sea to sea, and the country little cultivated; it is therefore united to Mercandal. In this last termino stands Mont-toro in the very centre of the isle, and the highest ground, some say the only mountain in it; on the summit of which there is a convent, where even in the hottest months the monks enjoy a cool air, and at all times a most delightful prospect. About six miles north from Mont-toro stands the castle that covers Port-Fornelles, which is a very spacious harbour on the east side of the island. There are in it shoals and foul ground, which, to those who are unacquainted with them, render it difficult and dangerous; yet the packets bound from Mahon to Marseilles frequently take shelter therein; and while the Spaniards were in possession of the isle, large ships and men of war frequented it. At a small distance from this lies another harbour called *Adia*, which runs far into the land; but being reputed unsafe, and being so near Fornelles, is at present useless. The country about it is, however, said to be the pleasantest and wholesomest spot in the island, and almost the only one plentifully supplied with excellent spring water; so that the gardens are well laid out, and the richest and finest fruits grow here in the highest perfection. Alaior is the next termino, in which there is nothing remarkable but the capital of the same name, well situated on an eminence, in a pleasant and tolerably cultivated country.

The termino of Mahon, at the south-east end of the island, is at present the most considerable of them all, containing about 60,000 English acres, and nearly one-half of the inhabitants in Minorca. The town of Mahon derives its name from the Carthaginian general Mago, who is universally allowed to be its founder.—It stands on an eminence on the west side of the harbour, the ascent pretty steep. There are in it a large church, three convents, the governor's palace, and some other public edifices. It is large, but the streets are winding, narrow, and ill paved. The fortress of St Philip stands near the entrance of the harbour, which it covers; is very spacious, of great strength, with subterranean works to protect the garrison from bombs, large magazines, and whatever else is necessary to render it a complete fortification, and hath a numerous and well disposed artillery. Port Mahon is allowed to be the finest harbour in the Mediterranean, about 90 fathoms wide at its entrance, but within very large and safe, stretching a league or more into the land. Beneath the town of Mahon there is a very fine quay, one end of which is reserved for the ships of war, and furnished with all the accommodations necessary for careening and refitting them; the other serves for merchantmen.

On

Minorca || Minotaur.

On the other side of the harbour is Cape Mola, where it is generally agreed a fortress might be constructed which would be impregnable, as the castle of St Philip was esteemed before we took it, and bestowed so much money upon it, that though some works were erected at Cape Mola, it was not judged proper to proceed in the fortifications there at a fresh expence; at least this is the only reason that hath been assigned. Minorca was taken by the Spaniards during the American war, and is now in their possession.

MINORS, or FRIARS MINOR, an appellation which the Franciscans assume, out of show of humility; calling themselves *fratres minores*, i. e. lesser brothers, and sometimes *minorites*. There is also an order of regular minors at Naples, which was established in the year 1588, and confirmed by Sixtus V.

MINOS, in *Fabulous History*, a king of Crete, son of Jupiter and Europa. He flourished about 1432 years before the Christian era. He gave laws to his subjects, which still remained in full force in the age of the philosopher Plato, about 1000 years after the death of the legislator. His justice and moderation procured him the appellation of the favourite of the gods, the confidant of Jupiter, and the wise legislator, in every city of Greece; and, according to the poets, he was rewarded for his equity after death with the office of supreme and absolute judge in the infernal regions. In this capacity he is represented sitting in the middle of the shades, and holding a sceptre in his hand. The dead plead their different causes before him; and the impartial judge shakes the fatal urn, which is filled with the destinies of mankind. He married Ithona, by whom he had Lycastes, who was the father of Minos II.

MINOS II. was a son of Lycastes, the son of Minos I. and king of Crete. He married Pasiphae, the daughter of Sol and Perseis, and by her he had many children. He increased his paternal dominions by the conquest of the neighbouring islands; but showed himself cruel in the war which he carried on against the Athenians, who had put to death his son Androgeus. He took Megara by the treachery of Scylla; and not satisfied with victory, he obliged the vanquished to bring him yearly to Crete seven chosen boys and the same number of virgins to be devoured by the MINOTAUR. This bloody tribute was at last abolished when THESEUS had destroyed the monster. When DÆDALUS, whose industry and invention had fabricated the labyrinth, and whose imprudence in assisting Pasiphae in the gratification of her unnatural desires, had offended Minos, fled from the place of his confinement with wings, and arrived safe in Sicily; the incensed monarch pursued the offender, resolved to punish his infidelity. Cocalus, king of Sicily, who had hospitably received Dædalus, entertained his royal guest with dissembled friendship; and, that he might not deliver to him a man whose ingenuity and abilities he so well knew, he put Minos to death. Minos died about 35 years before the Trojan war. He was father of Androgeus, Glaucus, and Deucalion; and two daughters Phædra, and Ariadne. Many authors have confounded the two Minoses, the grandfather and the grandson; but Homer, Plutarch, and Diodorus, prove plainly that they were two different persons.

MINOTAUR, in *Fabulous History*, a celebrated monster, half a man and half a bull, according to this verse of Ovid, Minotaur || Minstrel.

Semibovemque virum, semivirumque bovem.

It was the fruit of Pasiphae's amour with a bull. Minos refused to sacrifice a white bull to Neptune, an animal which he had received from the god for that purpose. This offended Neptune, and he made Pasiphae the wife of Minos enamoured of this fine bull, which had been refused to his altars. Dædalus prostituted his talents in being subservient to the queen's unnatural desires; and by his means, Pasiphae's horrible passions were gratified, and the Minotaur came into the world. Minos confined in the labyrinth this monster, which convinced the world of his wife's lasciviousness, and reflected disgrace upon his family. The Minotaur usually devoured the chosen young men and maidens which the tyranny of Minos yearly exacted from the Athenians. Theseus delivered his country from this tribute, when it had fallen to his lot to be sacrificed to the voracity of the Minotaur; and by means of Ariadne, the king's daughter, he destroyed the monster, and made his escape from the windings of the labyrinth.—The fabulous tradition of the Minotaur, and of the infamous commerce of Pasiphae with a favourite bull, has been often explained. Some suppose that Pasiphae was enamoured of one of her husband's courtiers called *Taurus;* and that Dædalus favoured the passions of the queen, by suffering his house to become the retreat of the two lovers. Pasiphae some time after brought twins into the world, one of whom greatly resembled Minos and the other Taurus; and in the natural resemblance of their countenance with that of their supposed fathers, originated their name, and consequently the fable of the Minotaur.

MINOW, a very small species of cyprinus. See ICHTHYOLOGY *Index*.

MINSTER, (Saxon, *Mynster* or *Mynstre*), anciently signified the church of a monastery or convent.

MINSTREL, an ancient term for a singer and instrumental performer.

The word *minstrel* is derived from the French *menestrier*, and was not in use here before the Norman conquest. It is remarkable that our old monkish historians do not use the words *citharœdus*, *cantator* or the like, to express a *minstrel* in Latin; but either *mimus*, *histrio*, *joculator*, or some other word that implies *gesture*. Hence it should seem that the minstrels set off their singing by mimicry or action; or, according to Dr Brown's hypothesis, united the powers of melody, poem, and dance.

The Saxons as well as the ancient Danes, had been accustomed to hold men of this profession in the highest reverence. Their skill was considered as something divine, their persons were deemed sacred, their attendance was solicited by kings, and they were everywhere loaded with honours and rewards. In short, poets and their art were held among them in that rude admiration which is ever shown by an ignorant people to such as excel them in intellectual accomplishments. When the Saxons were converted to Christianity, in proportion as letters prevailed among them this rude admiration began to abate, and poetry was no longer a peculiar profession. The poet and the minstrel be-

Minstrel. came two persons. Poetry was cultivated by men of letters indiscriminately, and many of the most popular rhymes were composed amidst the leisure and retirement of monasteries. But the minstrels continued a distinct order of men, and got their livelihood by singing verses to the harp at the houses of the great. There they were still hospitably and respectfully received, and retained many of the honours shown to their predecessors the Bards and Scalds. And indeed, though some of them only recited the compositions of others, many of them still composed songs themselves: and all of them could probably invent a few stanzas on occasion. There is no doubt but most of the old heroic ballads were produced by this order of men. For although some of the larger metrical romances might come from the pen of the monks or others, yet the smaller narratives were probably composed by the minstrels who sung them. From the amazing variations which occur in different copies of these old pieces, it is evident they made no scruple to alter each other's productions, and the reciter added or omitted whole stanzas according to his own fancy or convenience.

In the early ages, as is hinted above, this profession was held in great reverence among the Saxon tribes, as well as among their Danish brethren. This appears from two remarkable facts in history, which show that the same arts of music and song were equally admired among both nations, and that the privileges and honours conferred upon the professors of them were common to both; as it is well known their customs, manners, and even language, were not in those times very dissimilar.

When King Alfred the Great was desirous to learn the true situation of the Danish army, which had invaded his realm, he assumed the dress and character of a minstrel; and taking his harp, and only one attendant (for in the earliest times it was not unusual for a minstrel to have a servant to carry his harp), he went with the utmost security into the Danish camp. And though he could not but be known to be a Saxon, the character he had assumed procured him an hospitable reception; he was admitted to entertain the king at table, and staid among them long enough to contrive that assault which afterwards destroyed them. This was in the year 878.

About 60 years after, a Danish king made use of the same disguise to explore the camp of King Athelstan. With his harp in his hand, and dressed like a minstrel, Anlaff king of the Danes went among the Saxon tents, and taking his stand near the king's pavilion, began to play, and was immediately admitted. There he entertained Athelstan and his lords with his singing and his music; and was at length dismissed with an honourable reward, though his songs must have discovered him to have been a Dane. Athelstan was saved from the consequences of this stratagem by a soldier, who had observed Anlaff bury the money which had been given him, from some scruple of honour or motive of superstition. This occasioned a discovery.

From the uniform procedure of both these kings, it is plain that the same mode of entertainment prevailed among both peoples, and that the minstrel was a privileged character among both. Even as late as the reign of Edward II. the minstrels were easily admitted into the royal presence, as appears from a passage in Stow, which also shows the splendour of their appearance. Minstrel.

"In the year 1316, Edward II. did solemnize his feast of Pentecost at Westminster, in the great hall; where sitting royally at the table with his peers about him, there entered a woman adorned like a minstrel, sitting on a great horse trapped, as minstrels then used, who rode round about the tables, showing pastime; and at length came up to the king's table and laid before him a letter, and forthwith turning her horse, saluted every one, and departed."—The subject of this letter was a remonstrance to the king on the favours heaped by him on his minions, to the neglect of his knights and faithful servants.

The messenger was sent in a minstrel's habit, as what would gain an easy admission; and was a woman concealed under that habit, probably to disarm the king's resentment; for we do not find that any of the real minstrels were of the female sex; and therefore conclude this was only an artful contrivance peculiar to that occasion.

In the 4th year of Richard II. John of Gaunt erected at Tetbury in Staffordshire a court of minstrels, with a full power to receive suit and service from the men of that profession within five neighbouring counties, to enact laws, and determine their controversies; and to apprehend and arrest such of them as should refuse to appear at the said court, annually held on the 16th of August. For this they had a charter, by which they were empowered to appoint a king of the minstrels with four officers to preside over them. These were every year elected with great ceremony; the whole form of which is described by Dr Plott; in whose time, however, they seem to have become mere musicians.

Even so late as the reign of King Henry VIII. the reciters of verses or moral speeches learnt by heart, intruded without ceremony into all companies; not only in taverns, but in the houses of the nobility themselves. This we learn from Erasmus, whose argument led him only to describe a species of these men who did not sing their compositions; but the others that did, enjoyed without doubt the same privileges.

We find that the minstrels continued down to the reign of Elizabeth; in whose time they had lost much of their dignity, and were sinking into contempt and neglect. Yet still they sustained a character far superior to any thing we can conceive at present of the singers of old ballads.

When Queen Elizabeth was entertained at Killingworth castle by the earl of Leicester in 1575, among the many devices and pageants which were exhibited for her entertainment, one of the personages introduced was that of an ancient minstrel, whose appearance and dress are so minutely described by a writer there present, and gives us so distinct an idea of the character, that we shall quote the passage at large.

"A person very meet seemed he for the purpose, of a xlv. years old, apparelled partly as he would, himself. His cap off: his head seemingly rounded tonsterwise: fair kembed, that, with a sponge daintly dipt in a little capon's grease, was finely smoothed, to make it shine like a mallard's wing. His beard snugly shaven:

Minstrel, Mint.

shaven: and yet his shirt after the new trink, with ruffs fair starched, sleeked, and glistering like a pair of new shoes, marshalled in good order with a setting stick, and strut, 'that' every ruff stood up like a wafer. A side [i. e. long] gown of Kendale green, after the freshness of the year now, gathered at the neck with a narrow gorget, fastened afore with a white clasp and a keeper close up to the chin; but easily, for heat, to undo when he list. Seemingly begirt in a red caddis girdle: from that a pair of capped Sheffield knives hanging a' two sides. Out of his bosom drawn from a lappet of his napkin edged with a blue lace, and marked with a D for Damian; for he was but a bachelor yet.

"His gown had side [i. e. long] sleeves down to midleg, slit from the shoulder to the hand, and lined with white cotton. His doublet sleeves of black worsted: upon them a pair of points of tawny chamlet laced along the wrist with blue threaden pointes. A wealt towards the hands of fustian-a-napes. A pair of red neather stocks. A pair of pumps on his feet, with a cross cut at his toes for corns; not new indeed, yet cleanly blackt with soot, and shining as a shoing horn.

"About his neck a red ribband suitable to his girdle. His harp in good grace dependent before him. His wrest tyed to a green lace and hanging by: under the gorget of his gown a fair flaggon chain (pewter for) silver, as a Squire Minstrel of Middlesex, that travelled the country this summer season, unto fair and worshipful men's houses. From his chain hung a scutcheon, with metal and colour, resplendent upon his breast, of the ancient arms of Islington."

—This minstrel is described as belonging to that village. We suppose such as were retained by noble families wore their arms hanging down by a silver chain as a kind of badge. From the expression of Squire Minstrel above, we may conclude there were other inferior orders, as Yeomen Minstrels or the like.

This minstrel, the author tells us a little below, "after three lowly courtesies, cleared his voice with a hem . . . and wiped his lips with the hollow of his hand for 'filing his napkin; tempered a string or two with his wrist; and, after a little warbling on his harp for a prelude, came forth with a solemn song, warranted for story out of King Arthur's acts, &c."

Towards the end of the 16th century, this class of men had lost all credit, and were sunk so low in the public opinion, that in the 39th year of Elizabeth a statute was passed by which "minstrels," wandering abroad, were included among "rogues, vagabonds, and sturdy beggars," and were adjudged to be punished as such. This act seems to have put an end to the profession, for after this time they are no longer mentioned.

MINT, the place in which the king's money is coined. See COINAGE.

There were anciently mints in almost every county in England; but the only mint at present in the British dominions is that in the Tower of London. The officers of the mint are, 1. The warden of the mint, who is the chief; he oversees the other officers, and receives the bullion. 2. The master worker, who receives bullion from the wardens, causes it to be melted, delivers it to the moneyers, and, when it is coined, receives it again. 3. The comptroller, who is the overseer of all the inferior officers, and sees that all the money is made to the just assize. 4. The assay master, who weighs the gold and silver, and sees that it is according to the standard. 5. The two auditors who take the accounts. 6. The surveyor of the melting; who, after the assay master has made trial of the bullion, sees that it is cast out, and not altered after it is delivered to the melter. 7. The engraver; who engraves the stamps and dies for the coinage of the money. 8. The clerk of the irons; who sees that the irons are clean and fit to work with. 9. The melter, who melts the bullion before it be coined. 10. The provost of the mint; who provides for and oversees all the moneyers. 11. The blanchers, who anneal and cleanse the money. 12. The moneyers; some of whom forge the money, some share it, some round and mill it, and some stamp and coin it. 13. The porters who keep the gate of the mint.

Mint.

MINT was also a pretended place of privilege, in Southwark, near the King's Bench, put down by statute. If any persons, within the limits of the mint, shall obstruct any officer in the serving of any writ or process, &c. or assault any person therein, so as he receive any bodily hurt, the offender shall be guilty of felony, and be transported to the plantations, &c. Stat. 9. Geo. I.

MINT Marks. It hath been usual, from old time, to oblige the masters and workers of the mint, in the indentures made with them, "to make a privy mark in all the money that they made, as well of gold as of silver, so that another time they might know, if need were, and witte which moneys of gold and silver among other of the same moneys, were of their own making, and which not." And whereas, after every trial of the pix at Westminster, the masters and workers of the mint, having there proved their moneys to be lawful and good, were immediately entitled to receive their *quietus* under the great seal, and to be discharged from all suits or actions concerning those moneys, it was then usual for the said masters and workers to change the privy mark before used for another, that so the moneys from which they were not yet discharged might be distinguished from those for which they had already received their *quietus*: which new mark they then continued to stamp upon all their moneys, until another trial of the pix gave them also their *quietus* concerning those.

The pix is a strong box with three locks, whose keys are respectively kept by the warden, master, and comptroller of the mint; and in which are deposited, sealed up in several parcels, certain pieces taken at random out of every *journey* as it is called; that is, out of every 15 pounds weight of gold, or 60 pounds weight of silver, before the same is delivered to the proprietors. And this pix is, from time to time, by the king's command, opened at Westminster, in the presence of the lord chancellor, the lords of the council, the lords commissioners of the treasury, the justices of the several benches, and the barons of the exchequer; before whom a trial is made, by a jury of goldsmiths impannelled and sworn for that purpose, of the collective weights of certain parcels of the several pieces of gold and silver taken at random from those contained in the pix; after which those parcels being severally melted, assays are then made of the bullion

Mint || Minuet.

bullion of gold and silver so produced, by the melting certain small quantities of the same against equal weights taken from the respective trial pieces of gold and silver that are deposited and kept in the exchequer for that use. This is called the *trial of the pix;* the report made by the jury upon that trial is called the *verdict of the pix* for that time; and the indented trial pieces just above mentioned, are certain plates of standard gold and standard silver, made with the greatest care, and delivered in upon oath, from time to time as there is occasion, by a jury of the most able and experienced goldsmiths, summoned by virtue of a warrant from the lords of the treasury to the wardens of the mystery of goldsmiths of the city of London for that purpose; and which plates being so delivered in, are divided each, at this time, into seven parts by indentures, one of which parts is kept in his majesty's court of exchequer at Westminster, another by the said company of goldsmiths, and two more by the officers of his majesty's mint in the Tower; the remaining three being for the use of the mint, &c. in Scotland. The pix has sometimes been tried every year, or even oftener, but sometimes not more than once in several years: and from hence is understood how it comes to pass, that, among the pieces that are dated as well as marked, three or more different dates are sometimes found upon pieces impressed with the same mark: and again, that different marks are found upon pieces bearing the same date. These marks are first observable upon the coins of King Edward III.; the words above quoted concerning those marks are from the indentures made with the lord Hastings, master and worker to King Edward IV; and the marks themselves continued to be stamped very conspicuously upon the moneys, till the coinage by the mill and screw was introduced and settled after the Restoration, in the year 1662; since which time, the moneys being made with far greater regularity and exactness than before, these marks have either been totally laid aside, or such only have been used as are of a more secret nature, and only known to the officers and engravers concerned in the coinage: and, indeed the constant practice that has ever since prevailed, of dating all the several pieces, has rendered all such marks of much less consequence than before.

MINT. See MENTHA, BOTANY and MATERIA MEDICA *Index*.

MINTURNÆ, a town of Campania, between Sinuessa and Formiæ. It was in the marshes in this neighbourhood that Marius concealed himself in the mud to avoid the partizans of Sylla. The people condemned him to death; but when his voice alone had terrified the executioner, they showed themselves compassionate and favoured his escape.

MINUET, a very graceful kind of dance, consisting of a coupee, a high step, and a balance: it begins with a beat, and its motion is triple.

The invention of the minuet seems generally to be ascribed to the French, and particularly to the inhabitants of the province of Poictou. The word is said by Menage and Furetiere to be derived from the French *menue* or *menu*, "small or little;" and in strictness signifies a small space. The melody of this dance consists of two strains, which, as being repeated, are called *reprises*, each having eight or more bars, but never an odd number. The measure is three crotchets in a bar, and is thus marked $\frac{3}{4}$, though it is commonly performed in the time $\frac{3}{8}$. Walther speaks of a minuet in Lully's opera of *Roland*, each strain of which contains ten bars, the sectional number being 5; which renders it very difficult to dance.

Minuet || Miracle.

MINUTE, in *Geometry*, the 60th part of a degree of a circle.

Minute of Time, the 60th part of an hour.

MINUTE, in *Architecture*, usually denotes the 60th, sometimes the 30th, part of a module. See ARCHITECTURE.

MINUTE is also used for a short memoir, or sketch of a thing taken in writing.

MINUTIUS FELIX. See FELIX.

MINYÆ, a name given to the inhabitants of Orchomenos in Bœotia, from Minyas king of the country. Orchomenos the son of Minyas gave his name to the capital of the country; and the inhabitants still retained their original appellation, in contradistinction to the Orchomenians of Arcadia. A colony of Orchomenians passed into Thessaly and settled in Iolchos; from which circumstance the people of the place, and particularly the Argonauts, were called *Minyæ*. This name they received, according to the opinion of some, not because a number of Orchomenians had settled among them, but because the chief and noblest of them were descended from the daughters of Minyas. Part of the Orchomenians accompanied the sons of Codrus when they migrated to Ionia. The descendants of the Argonauts, as well as the Argonauts themselves, received the name of *Minyæ*. They first inhabited Lemnos, where they had been born from the Lemnian women who had murdered their husbands. They were driven from Lemnos by the Pelasgi, about 1160 before the Christian era, and come to settle in Laconia, from whence they passed into Calliste with a colony of Lacedæmonians.

MIQUELETS, a name given to the Spaniards who inhabit the Pyrenean mountains on the frontiers of Arragon and Catalonia, and live by robbing.

MIQUELON, a small desert island to the south-west of Cape May in Newfoundland, ceded to the French by the peace of 1763, for drying and curing their fish. W. Long. 54. 30. N. Lat. 47. 22.

MIRABILIS, MARVEL OF PERU; a genus of plants belonging to the pentandria class; and in the natural method ranking with those of which the order is doubtful. See BOTANY *Index*.

MIRACLE, in its original sense, is a word of the same import with *wonder;* but in its usual and more appropriate signification, it denotes "an effect contrary to the established constitution and course of things, or a sensible deviation from the known laws of nature."

That the visible world is governed by stated general rules, or that there is an order of causes and effects established in every part of the system of nature which falls under our observation, is a fact which cannot be controverted. If the Supreme Being, as some have supposed, be the only real agent in the universe, we have the evidence of experience, that, in the particular system to which we belong, he acts by stated rules. If he employs inferior agents to conduct the various motions from which the phenomena result, we have the same evidence that he has subject-

ed

Miracle.

ed those agents to certain fixed laws, commonly called the *laws of nature*. On either hypothesis, effects which are produced by the regular operation of these laws, or which are conformable to the established course of events, are properly called *natural;* and every contradiction to this constitution of the natural system, and the correspondent course of events in it, is called a *miracle*.

If this definition of a miracle be just, no event can be deemed miraculous merely because it is strange, or even to us unaccountable; since it may be nothing more than a regular effect of some unknown law of nature. In this country earthquakes are rare; and for monstrous births perhaps no *particular* and satisfactory account can be given: yet an earthquake is as regular an effect of the established laws of nature as any of those with which we are most intimately acquainted; and under circumstances in which there would always be the same kind of production, the monster is nature's genuine issue. It is therefore necessary, before we can pronounce any effect to be a true miracle, that the circumstances under which it is produced be known, and that the common course of nature be in some degree understood; for in all those cases in which we are totally ignorant of nature, it is impossible to determine what is, or what is not, a deviation from its course. Miracles, therefore, are not, as some have represented them, appeals to our ignorance. They suppose some antecedent knowledge of the course of nature, without which no proper judgement can be formed concerning them; though with it their reality may be so apparent as to prevent all possibility of a dispute.

Thus, were a physician to cure a blind man of a cataract, by anointing his eyes with a chemical preparation which we had never before seen, and to the nature and effects of which we are absolute strangers, the cure would undoubtedly be *wonderful;* but we could not pronounce it *miraculous*, because, for any thing known to us, it might be the natural effect of the operation of the unguent on the eye. But were he to recover his patient merely by commanding him to see, or by anointing his eyes with spittle, we should with the utmost confidence pronounce the cure to be a miracle; because we know perfectly that neither the human voice nor human spittle have, by the established constitution of things, any such power over the diseases of the eye. No one is now ignorant, that persons apparently dead are often restored to their families and friends, by being treated in the manner recommended by the Humane Society. To the vulgar, and sometimes even to men of science, these effects appear very wonderful; but as they are known to be produced by physical agency, they can never be considered as miraculous deviations from the laws of nature. On the other hand, no one could doubt of his having witnessed a real miracle who had seen a person that had been four days dead come alive out of his grave at the *call* of another, or who had even beheld a person exhibiting all the *symptoms* of death instantly resuscitated merely by being *desired* to live.

Thus easy is it, in all cases in which the course of nature is understood, to determine whether any particular event be really a miracle; whilst in circumstances where we know nothing of nature and its course, even a true miracle, were it performed, could not be admitted as such, or carry any conviction to the mind of a philosopher. Miracle.

If miracles be effects contrary to the established constitution of things, we are certain that they will never be performed on trivial occasions. The constitution of things was established by the Creator and Governor of the universe, and is undoubtedly the offspring of infinite wisdom pursuing a plan for the best of purposes. From this plan no deviation can be made but by God himself, or by some powerful being acting with his permission. The plans devised by wisdom are steady in proportion to their perfection, and the plans of infinite wisdom must be absolutely perfect. From this consideration, some men have ventured to conclude, that no miracle was ever wrought, or can rationally be expected; but maturer reflection must soon satisfy us that all such conclusions are hasty.

Man is unquestionably the principal creature in this world, and apparently the only one in it who is capable of being made acquainted with the relation in which he stands to his Creator. We cannot, therefore, doubt, but that such of the laws of nature as extend not their operation beyond the limits of this earth were established chiefly, if not solely, for the good of mankind; and if, in any particular circumstances, that good can be more effectually promoted by an occasional deviation from those laws, such a deviation may be reasonably expected. Were man, in the exercise of his mental and corporeal powers, subjected to the laws of physical necessity, the circumstances supposed would indeed never occur, and of course no miracle could be admitted. But such is not the nature of man.

Without repeating what has been said elsewhere (See METAPHYSICS, Part III. Chap. V.) of necessity and liberty, we shall here take it for granted, that the relation between motives and actions is different from that between cause and effect in physics; and that, mankind have such command over themselves, as that by their voluntary conduct, they can make themselves in a great degree either happy or miserable. We know likewise from history, that, by some means or other, almost all mankind were once sunk into the grossest ignorance of the most important truths; that they knew not the Being by whom they were created and supported; that they paid divine adoration to stocks, stones, and the vilest reptiles; and that they were slaves to the most impious, cruel, and degrading superstitions.

From this depraved state it was surely not unworthy of the common "Father of all" to rescue his helpless creatures, to enlighten their understandings that they might perceive what is right, and to present to them motives of sufficient force to engage them in the practice of it. But the understandings of ignorant barbarians cannot be enlightened by arguments; because of the force of such arguments as regard moral science they are not qualified to judge. The philosophers of Athens and Rome inculcated, indeed, many excellent moral precepts, and they sometimes ventured to expose the absurdities of the reigning superstition: but their lectures had no influence upon the multitude; and they had themselves imbibed such erroneous notions respecting the attributes of the Supreme Being, and the nature of the human soul, and converted those notions into first principles, of which they would not

permit

Miracle. permit an examination, that even among them a thorough reformation was not to be expected from the powers of reasoning. It is likewise to be observed, that there are many truths of the utmost importance to mankind, which unassisted reason could never have discovered. Amongst these we may confidently reckon the immortality of the soul, the terms upon which God will be reconciled to sinners, and the manner in which that all-perfect Being may be acceptably worshipped; about all of which philosophers were in such uncertainty, that, according to Plato, "Whatever is set right, and as it should be, in the present evil state of the world, can be so only by the particular interposition of God (A).

An immediate revelation from Heaven, therefore, was the only method by which infinite wisdom and perfect goodness could reform a bewildered and vicious race. But this revelation, at whatever time we suppose it given, must have been made directly either to some chosen individuals commissioned to instruct others, or to every man and woman for whose benefit it was ultimately intended. Were every person instructed in the knowledge of his duty by immediate inspiration, and were the motives to practise it brought home to his mind by God himself, human nature would be wholly changed: men would not be masters of their own actions: they would not be moral agents, nor by consequence be capable either of reward or of punishment. It remains, therefore, that if God has been graciously pleased to enlighten and reform mankind, without destroying that moral nature which is essential to virtue, he can have done it only by revealing his truth to certain chosen instruments, who were the immediate instructors of their contemporaries, and through them have been the instructors of succeeding ages.

Let us suppose this to have been actually the case, and consider how those inspired teachers could communicate to others every truth which had been revealed to themselves. They might easily, if it was part of their duty, deliver a sublime system of natural and moral science, and establish it upon the common basis of experiment and demonstration; but what foundation could they lay for those truths which unassisted reason cannot discover, and which, when they are revealed, appear to have no necessary relation to any thing previously known? To a bare affirmation that they had been immediately received from God, no rational being could be expected to assent. The teachers might be men of known veracity, whose simple assertion would be admitted as sufficient evidence for any fact in conformity with the laws of nature; but as every man has the evidence of his own consciousness and experience that revelations from heaven are deviations from these laws, an assertion so apparently extravagant would be rejected as false, unless supported by some better proof than the mere affirmation of the teacher. In this state of things, we can conceive no evidence sufficient to make such doctrines be received as the truths of God, but the power of working miracles committed to him who taught them. This would, indeed, be fully adequate to the purpose. For if there were nothing in the doctrines themselves impious, immoral, or contrary to truths already known, the only thing which could render the teacher's assertion incredible, would be its implying such an intimate communion with God as is contrary to the established course of things, by which men are left to acquire all their knowledge by the exercise of their own faculties.—Let us now suppose one of those inspired teachers to tell his countrymen, that he did not desire them, on his *ipse dixit*, to believe that he had any preternatural communion with the Deity, but that for the truth of his assertion he would give them the evidence of their own senses; and after this declaration let us suppose him immediately to raise a person from the dead in their presence, merely by calling upon him to come out of his grave. Would not the only possible objection to the man's veracity be removed by this miracle? and his assertions that he had received such and such doctrines from God be as fully credited, as if it related to the most common occurrence? Undoubtedly it would; for when so much preternatural *power* was visibly communicated to this person, no one could have reason to question his having received an equal portion of preternatural *knowledge*. A palpable deviation from the known laws of nature, in one instance, is a sensible proof that such a deviation is possible in another; and in such a case as this, it is the witness of God to the truth of a man. Miracle

Miracles, then, under which we include prophecy, are the only direct evidence which can be given of divine inspiration. When a religion, or any religious truth, is to be revealed from heaven, they appear to be absolutely necessary to enforce its reception among men; and this is the only case in which we can suppose them necessary, or believe for a moment that they ever have been or will be performed.

The history of almost every religion abounds with relations of prodigies and wonders, and of the intercourse of men with the gods; but we know of no religious system, those of the Jews and Christians excepted, which appealed to miracles as the sole evidence of its truth and divinity. The pretended miracles mentioned by Pagan historians and poets are not said to have been publicly wrought to enforce the truth of a new religion contrary to the reigning idolatry. Many of them may be clearly shown to have been mere natural events; (see MAGIC). Others of them are represented as having been performed in secret on the most trivial occasions, and in obscure and fabulous ages long prior to the era of the writers by whom they are recorded. And such of them as at first view appear to be best attested, are evidently tricks contrived for interested purposes; to flatter power, or to promote the prevailing superstitions. For these reasons, as well as on account of the immoral character of the divinities by whom they are said to have been wrought, they are altogether unworthy of examination, and carry in the very nature of them the completest proofs of falsehood and imposture.

But

(A) Ευ γαρ χρη ειδεναι, ὁ τι περ αν σωθη τε και γενηται οἱον δει, εη τοιαυτη καταστασει πολιτειων. Θεου μοιραν αυτο σωσαι. De Repub. lib. vi.

Miracle. But the miracles recorded of Moses and of Christ bear a very different character. None of them is represented as wrought on trivial occasions. The writers who mention them were eye witnesses of the facts; which they affirm to have been performed publicly, in attestation of the truth of their respective systems. They are indeed so incorporated with these systems, that the miracles cannot be separated from the doctrines; and if the miracles were not really performed, the doctrines cannot possibly be true. Besides all this, they were wrought in support of revelations which opposed all the religious systems, superstitions, and prejudices, of the age in which they were given: a circumstance which of itself sets them, in point of authority, infinitely above the Pagan prodigies, as well as the lying wonders of the Romish church.

It is indeed, we believe, universally admitted, that the miracles mentioned in the book of Exodus and in the four Gospels, might, to those who saw them performed, be sufficient evidence of the divine inspiration of Moses and of Christ; but to us it may be thought that they are no evidence whatever, as we must believe in the miracles themselves, if we believe in them at all, upon the bare authority of human testimony. Why, it has been sometimes asked, are not miracles wrought in all ages and countries? If the religion of Christ was to be of perpetual duration, every generation of men ought to have complete evidence of its truth and divinity.

To the performance of miracles in every age and in every country, perhaps the same objections lie as to the immediate inspiration of every individual. Were those miracles universally received as such, men would be so overwhelmed with the *number* rather than with the *force* of their authority, as hardly to remain masters of their own conduct; and in that case the very end of all miracles would be defeated by their frequency. The truth, however, seems to be, that miracles so frequently repeated would not be received as such, and of course would have *no* authority; because it would be difficult, and in many cases impossible, to distinguish them from natural events. If they recurred regularly at certain intervals, we could not prove them to be deviations from the known laws of nature, because we should have the same experience for the one series of events as for the other; for the regular succession of preternatural effects, as for the established constitution and course of things.

Be this, however, as it may, we shall take the liberty to affirm, that for the reality of the Gospel miracles we have evidence as convincing to the reflecting mind, though not so striking to vulgar apprehension, as those had who were contemporary with Christ and his apostles, and actually saw the mighty works which he performed. To the admirers of Mr Hume's philosophy this assertion will appear an extravagant paradox; but we hope to demonstrate its truth from principles which, consistently with himself, that author could not have denied. He has indeed endeavoured to prove *, that "no testimony is sufficient to establish a miracle;" and the reasoning employed for this purpose is, that "a miracle being a violation of the laws of nature which a firm and unalterable experience has established, the proof against a miracle, from the very nature of the fact, is as entire as any argument from experience can be; whereas our experience of human veracity, which (according to him) is the sole foundation of the evidence of testimony, is far from being uniform, and can therefore never preponderate against that experience which admits of no exception." This boasted and plausible argument has with equal candour and acuteness been examined by Dr Campbell *, who justly observes, that so far is experience from being the sole foundation of the evidence of testimony, that, on the contrary, testimony is the sole foundation of by far the greater part of what Mr Hume calls firm and unalterable experience; and that if in certain circumstances we did not give an implicit faith to testimony, our knowledge of events would be confined to those which had fallen under the immediate observation of our own senses. For a short view of this celebrated controversy in which the Christian so completely vanquishes the philosopher, see the word ABRIDGMENT.

Miracle.

* *Essay on Miracles.*

* *Dissertation on Miracles.*

But though Dr Campbell has exposed the sophistry of his opponent's reasoning, and overturned the *principles* from which he reasons, we are persuaded that he might safely have joined issue with him upon those very principles. To us, at least, it appears that the testimony upon which we receive the Gospel miracles is precisely of that kind which Mr Hume has acknowledged sufficient to establish even a miracle. "No testimony (says he) is sufficient to establish a miracle, unless the testimony be of such a kind that its falsehood would be more miraculous than the fact which it endeavours to establish. When one tells me that he saw a dead man restored to life, I immediately consider with myself whether it be more probable that this person should either deceive or be deceived, or that the fact which he relates should really have happened. I weigh the one miracle against the other; and according to the superiority which I discover, I pronounce my decision, and always reject the greater miracle." In this passage every reader may remark what did not escape the perspicacious eye of Dr Campbell, a strange confusion of terms; but as all miracles are equally easy to the Almighty; and as Mr Hume has elsewhere observed, that "the raising of a feather, when the wind wants ever so little of a force requisite for that purpose, is as real a miracle as the raising of a house or a ship into the air;" candour obliges us to suppose, that by talking of greater and less miracles and of always rejecting the *greater*, he meant nothing more, but that of two deviations from the known laws of nature he always rejects that which in itself is least probable.

If, then, we can show that the testimony given by the apostles and other first preachers of Christianity to the miracles of their Master would, upon their supposition that those miracles were not really performed, have been as great a deviation from the known laws of nature as the miracles themselves, the balance must be considered as evenly poised by opposite miracles; and whilst it continues so, the judgment must remain in a state of suspense. But if it shall appear, that in this case the false testimony would have been a deviation from the laws of nature less probable in itself than the miracles recorded in the Gospels, the balance will be instantly destroyed; and by Mr Hume's maxim we shall be obliged to reject the supposition of falsehood in the testimony

Miracle. of the apostles, and admit the miracles of Christ to have been really performed.

In this argument we need not waste time in proving that those miracles, as they are represented in the writings of the New Testament, were of such a nature, and performed before so many witnesses, that no imposition could possibly be practised on the senses of those who affirm that they were present. From every page of the Gospels this is so evident, that the philosophical adversaries of the Christian faith never suppose the apostles to have been themselves deceived, but boldly accuse them of bearing false witness. But if this accusation be well founded, their testimony itself is as great a miracle as any which they record of themselves or of their Master.

It has been shown elsewhere (see METAPHYSICS, N° 138.), that by the law of association, which is one of the laws of nature, mankind, in the very process of learning to speak, necessarily learn to speak the truth; that ideas and relations are in the mind of every man so closely associated with the words by which they are expressed in his native tongue, and in every other language of which he is master, that the one cannot be entirely separated from the other; that therefore no man can on any occasion speak falsehood without some *effort*; that by no effort can a man give consistency to an unpremeditated detail of falsehood, if it be of any length, and include a number of particulars; and that it is still less possible for several men to agree in such a detail, when at a distance from each other, and cross questioned by their enemies.

This being the case, it follows, if the testimony of the apostles to their own and their Master's miracles be false, either that they must have concerted a consistent scheme of falsehood, and agreed to publish it at every hazard; or that God, or some powerful agent appointed by him, must have dissolved all the associations formed in their minds between ideas of sense and the words of language, and arbitrarily formed new associations, all in exact conformity to each other, but all in direct contradiction to truth. One or other of these events must have taken place; because, upon the supposition of falsehood, there is no other alternative. But such a dissolution and formation of associations as the latter implies, must, to every man who shall attentively consider it, appear to be as real a miracle, and to require as great an exertion of power, as the resurrection of the dead. Nor is the supposed voluntary agreement of the apostles in a scheme of falsehood an event less miraculous. When they sat down to fabricate their pretended revelation, and to contrive a series of miracles to which they were unanimously to appeal for its truth, it is plain, since they proved successful in their daring enterprise, that they must have clearly foreseen every possible circumstance in which they could be placed, and have prepared consistent answers to every question that could be put to them by their most inveterate and most enlightened enemies; by the statesman, the lawyer, the philosopher, and the priest. That such foreknowledge as this would have been miraculous, will not surely be denied; since it forms the very attribute which we find it most difficult to allow even to God himself. It is not, however, the *only* miracle which this supposition would compel us to swallow. The very *resolution* of the apostles to propagate the belief of false miracles in support of such a religion as that which is taught in the New Testament, is as great a miracle as human imagination can easily conceive. Miracle.

When they formed this design, either they must have hoped to succeed, or they must have foreseen that they should fail in their undertaking; and in either case, they *chose evil for its own sake*. They could not, if they foresaw that they should fail, look for any thing but that contempt, disgrace, and persecution, which were then the inevitable consequences of an unsuccessful endeavour to overthrow the established religion. Nor could their prospects be brighter upon the supposition of their success. As they knew themselves to be false witnesses and impious deceivers, they could have no hopes beyond the grave; and by determining to oppose all the religious systems, superstitions, and prejudices of the age in which they lived, they wilfully exposed themselves to inevitable misery in the present life, to insult, and imprisonment, to stripes and death. Nor can it be said that they might look forward to power and affluence when they should, through sufferings, have converted their countrymen; for so desirous were they of obtaining nothing but *misery*, as the end of their mission, that they made their own persecution a test of the truth of their doctrines. They introduced the Master from whom they pretended to have received these doctrines as telling them, "that they were sent forth as sheep in the midst of wolves; that they should be delivered up to councils, and scourged in synagogues; that they should be hated of all men for his name's sake; that the brother should deliver up the brother to death, and the father the child; and that he who took not up his cross and followed after him was not worthy of him." The very system of religion, therefore, which they invented and resolved to impose upon mankind, was so contrived, that the worldly prosperity of its first preachers, and even their exemption from persecution, was incompatible with its success. Had these clear predictions of the Author of that religion, under whom the apostles acted only as ministers, not been verified, all mankind must have instantly perceived that their pretence to inspiration was false, and that Christianity was a scandalous and impudent imposture. All this the apostles could not but foresee when they formed their plan for deluding the world. Whence it follows, that when they resolved to support their pretended revelation by an appeal to forged miracles, they wilfully, and with their eyes open, exposed themselves to inevitable misery, whether they should succeed or fail in their enterprise; and that they concerted their measures so as not to admit of a possibility of recompense to themselves, either in this life or in that which is to come. But if there be a law of nature, for the reality of which we have better evidence than we have for others, it is, that "no man can choose misery for its *own sake*," or make the acquisition of it the ultimate end of his pursuit. The existence of other laws of nature we know by testimony and our own observation of the regularity of their effects. The existence of this law is made known to us not only by these means, but also by the still clearer and more conclusive evidence of our own consciousness.

Thus, then, do miracles force themselves upon our assent in every possible view which we can take of this interesting subject. If the testimony of the first preachers

Miracle || Mirandola.

preachers of Christianity was true, the miracles recorded in the Gospel were certainly performed, and the doctrines of our religion are derived from heaven. On the other hand, if that testimony was false, either God must have miraculously effaced from the minds of those by whom it was given all the associations formed between their sensible ideas and the words of language, or he must have endowed those men with the gift of prescience, and have impelled them to fabricate a pretended revelation for the purpose of deceiving the world, and involving themselves in certain and forcseen destruction.

The power necessary to perform the one series of these miracles may, for any thing known to us, be as great as that which would be requisite for the performance of the other; and, considered merely as exertions of preternatural power, they may seem to balance each other, and to hold the mind in a state of suspense. But when we take into consideration the different purposes for which these opposite and contending miracles were wrought, the balance is instantly destroyed. The miracles recorded in the Gospels, if real, were wrought in support of a revelation which, in the opinion of all by whom it is received, has brought to light many important truths which could not otherwise have been made known to men; and which, by the confession of its adversaries, contains the purest moral precepts by which the conduct of mankind was ever directed. The opposite series of miracles, if real, was performed to enable, and even to compel, a company of Jews, of the lowest rank and of the narrowest education, to fabricate, with the view of inevitable destruction to themselves, a consistent scheme of falsehood, and by an appeal to forged miracles to impose it upon the world as a revelation from heaven. The object of the former miracles is worthy of a God of infinite wisdom, goodness, and power. The object of the latter is absolutely inconsistent with wisdom and goodness, which are demonstrably attributes of that Being by whom alone miracles can be performed. Whence it follows, that the supposition of the apostles hearing *false* testimony to the miracles of their Master, implies a series of deviations from the laws of nature, infinitely less probable in themselves than those miracles: and therefore by Mr Hume's maxim, we must necessarily reject the supposition of falsehood in the testimony, and admit the reality of the miracles. So true it is, that for the reality of the Gospel miracles we have evidence as convincing to the reflecting mind, as those had who were contemporary with Christ and his apostles, and were actual witnesses to their mighty works.

MIRANDA-DE-EBRO, a town of Spain, in Old Castile, with a strong castle; seated in a country that produces excellent wine. W. Long. 3. 10. N. Lat. 42. 52.

MIRANDO-DE-DOURO, or *Ducro*, a strong town of Portugal, and capital of the province of Tra-los-Montes, with a bishop's see. It is well fortified, and seated on a rock near the confluence of the rivers Douro and Fresna. W. Long. 5. 40. N. Lat. 41. 30.

MIRANDOLA, a town of Italy, and capital of a duchy of the same name, situated between the duchies of Mantua and Modena; is well fortified, and has also a strong citadel and fort. It has been several times taken and retaken. E. Long. 11. 5. N. Lat. 44. 52.

Miriam || Mi-adventure.

MIRIAM, sister of Aaron and Moses, makes two or three remarkable appearances in Scripture. It was owing to her that her mother was employed by Pharaoh's daughter as nurse to Moses. She put herself at the head of the women of Israel after their passage through the Red sea, in order to sing the song which the men had sung before. She joined with her brother Aaron in murmuring against Moses, and was severely chastised for that action; for she became leprous, and continued separate from the rest without the camp for seven days. She died before her brothers, though in the same year with them, and was buried at the public expence.

MIRROR, a name for a looking glass, or any polished body, whose use is to form the images of distant objects, by reflection of the rays of light. See REFLECTION.

Mirrors are either plane, convex, or concave. The first reflect the rays of light in a direction exactly similar to that in which they fall upon them, and therefore represent bodies of their natural magnitude. The convex ones make the rays diverge much more than before reflection, and therefore greatly diminish the images of those objects which they show: while the concave ones, by collecting the rays into a focus, not only magnify the objects they show, but will burn very fiercely when exposed to the rays of the sun; and hence they are commonly known by the name of *burning mirrors*. See *BURNING Mirrors*.

In ancient times the mirrors were made of some kind of metal; and from a passage of the Mosaic writings we learn that the mirrors used by the Jewish women were made of brass. The Jews certainly had been taught to use that kind of mirrors by the Egyptians; from whence it is probable that brazen mirrors were the first kind used in the world. Any kind of metal, indeed, when well polished, will reflect very powerfully; but of all others silver reflects the most, though it has been in all countries too expensive a material for common use. Gold also is very powerful; and metals, or even wood, gilded and polished, will act very powerfully as burning mirrors. Even polished ivory, or straw nicely plaited together, will form mirrors capable of burning, if on a large scale.

Since the invention of glass, and the application of quicksilver to it, became generally known, it hath been universally employed for those plane mirrors used as ornaments to houses; but in making reflecting telescopes, they have been found much inferior to metallic ones. It does not appear that the same superiority belongs to the metalline burning mirrors, considered merely as burning glasses; since the mirror with which M. Macquer melted platina, though only 22 inches diameter, and which was made of quicksilvered glass, produced much greater effects than M. Vilette's metalline speculum, which considerably exceeded it in size. It is very probable, however, that this mirror of M. Vilette's was by no means so well polished as it ought to have been; as the art of preparing the metal for taking the finest polish has but lately been discovered and published in the Philosophical Transactions by Mr Mudge. See *GLASS-Grinding*.

MIRE-CROW, SEA-CROW, or *Pewit*. See LARUS, ORNITHOLOGY *Index*.

MISADVENTURE, in common language, signifies

Misadventure || Mischna.

fies any unlucky accident which takes place without being foreseen.

MISADVENTURE, in *Law*, has an especial signification for the killing a man partly by negligence, and partly by chance. See HOMICIDE.

MISANTHROPY (from μισος, *hatred*, and ανθρωπος, a *man*); a general dislike or aversion to man, and mankind. In which sense it stands opposed to *philanthropy*, or the love of mankind.

MISCARRIAGE. See ABORTION and MIDWIFERY.

MISCHNA, or MISNA, (from שנה, *iteravit*), a part of the Jewish Talmud.

The Mischna contains the text; and the Gemara, which is the second part of the Talmud, contains the commentaries: so that the Gemara is, as it were, a glossary on the Mischna.

The Mischna consists of various traditions of the Jews, and of explanations of several passages of Scripture: these traditions serving as an explication of the written law, and supplement to it, are said to have been delivered to Moses during the time of his abode on the Mount; which he afterwards communicated to Aaron, Eleazar, and his servant Joshua. By these they were transmitted to the 70 elders, by them to the prophets, who communicated them to the men of the great sanhedrim, from whom the wise men of Jerusalem and Babylon received them. According to Prideaux's account, they passed from Jeremiah to Baruch, from him to Ezra, and from Ezra to the men of the great synagogue, the last of whom was Simon the Just; who delivered them to Antigonus of Socho; and from him they came down in regular succession to Simeon, who took our Saviour in his arms; to Gamaliel, at whose feet Paul was educated; and last of all to Rabbi Judah the Holy, who committed them to writing in the Mischna. But Dr Prideaux, rejecting this Jewish fiction, observes, that after the death of Simon the Just, about 299 years before Christ, the Mischnical doctors arose, who, by their comments and conclusions, added to the number of those traditions which had been received and allowed by Ezra and the men of the great synagogue; so that towards the middle of the second century after Christ, under the empire of Antoninus Pius, it was found necessary to commit these traditions to writing; more especially, as their country had considerably suffered under Adrian, and many of their schools had been dissolved, and their learned men cut off; and therefore the usual method of preserving their traditions had failed. Rabbi Judah on this occasion being rector of the school at Tiberias, and president of the sanhedrim in that place, undertook the work, and compiled it in six books, each consisting of several tracts, which altogether make up the number of 63. *Prid. Connex.* vol. ii. p. 468, &c. edit. 9. This learned author computes, that the Mischna was composed about the 150th year of our Lord; but Dr Lightfoot says, that Rabbi Judah compiled the Mischna about the year of Christ 190, in the latter end of the reign of Commodus; or, as some compute, in the year of Christ 220. Dr Lardner is of opinion, that this work could not have been finished before the year 190, or later. Collect. of Jewish and Heathen Testimonies, &c. vol. i. p. 178. Thus the book called the *Mischna* was formed; a book which the Jews have generally received with the greatest veneration. The original has been published with a Latin translation by Surenhusius, with notes of his own, and others from the learned Maimonides, &c. in 6 vol. fol. Amsterd. A. D. 1698—1703. (See TALMUD). It is written in a much purer style, and is not near so full of dreams and visions as the Gemara.

Mischna || Misenum.

MISDEMEANOUR, in *Law*, signifies a crime. Every crime is a misdemeanour; yet the law has made a distinction between crimes of a higher and a lower nature; the latter being denominated *misdemeanours*, the former *felonies*, &c. For the understanding of which distinction, we shall give the following definition from Blackstone's Commentaries, vol. iv. 5.

"A crime, or misdemeanour, is an act *committed* or *omitted*, in violation of a public law, either forbidding or commanding it. This general definition comprehends both *crimes* and *misdemeanours*; which, properly speaking, are mere synonymous terms; though, in common usage, the word *crime* is made to denote such offences as are of a deeper and more atrocious dye; while smaller faults, and omissions of less consequence, are comprised under the gentler name of *misdemeanours* only."

MISE, in law books, is used in various senses: thus it sometimes signifies costs or expences; in which sense it is commonly used in entering of judgments in actions personal. It is also used for the issue to be tried on the grand assize; in which case, joining of the mise upon the mere right, is putting in issue between the tenant and demandant, Who has the best or clearest right.

MISE, also signifies a tax or tallage, &c. An honorary gift, or customary present from the people of Wales to every new king or prince of Wales, anciently given in cattle, wine, and corn, but now in money, being 5000l. or more, is denominated a *mise*: so was the usual tribute or fine of 3000 merks paid by the inhabitants of the county palatine of Chester at the change of every owner of the said earldom, for enjoying their liberties. And at Chester they have a mise-book, wherein every town and village in the county is rated what to pay towards the mise. The 27 Hen. VIII. c. 26. ordains that lords shall have all such mises and profits of their lands as they had in times past, &c.

MISE, is sometimes also corruptly used for *mease*, in law French *mees*, "a messuage;" as a *mise place*, in some manors, is such a messuage or tenement as answers the lord a heriot at the death of its owner.—2 *Inst.* 528.

MISENUM, or MISENUS, in *Ancient Geography*; a promontory, port, and town in Campania, situated to the south-west of Baiæ, in the Sinus Puteolanus, on the north side. Here Augustus had a fleet, called *Classis Misenensis*, for guarding the Marc Inferum; as he had another at Ravenna for the Superum.

On this peninsula a villa was built by Caius Marius, with a degree of elegance that gave great offence to the most austere among the Romans, who thought it ill suited to the character of so rough a soldier. Upon the same foundation Lucullus the plunderer of the eastern world, erected an edifice, in comparison of which the former house was a cottage; but even his magnificence was eclipsed by the splendour of the palace which the emperors raised upon the same spot. To these proud abodes

Misenum, Miser.

abodes of heroes and monarchs, which have long been levelled to the ground, a few fishing huts, as Mr Swinburne informs us, and a lonely public house, have succeeded: hither boatmen resort to tipple perhaps on the identical site where the voluptuous masters of the world quaffed Chian and Falernian wines.

MISER, a parsimonious person who is at the same time rich; or a wretch covetous to extremity, whom avarice has divested of all the charities of human nature, and made even an enemy to himself.

Of this most unaccountable of all characters, many instances occur; some of them so extraordinary as almost to surpass belief. The following are here selected, as being of recent date, perfectly authentic, and the last of them in particular exhibiting an assemblage of qualities the most singular perhaps that ever existed in the same person. Too little dignified to merit a place in regular biography, yet too curious a variety of human character to pass unnoticed in this work, the present seemed the only title under which it could with propriety be introduced.

1. In December 1790, died at Paris, literally of want, Mr Ostervald, a well known banker. This man, originally of Neufchatel, felt the violence of the disease of avarice (for surely it is rather a disease than a passion of the mind) so strongly, that within a few days of his death, no importunities could induce him to buy a few pounds of meat for the purpose of making a little soup for him. "'Tis true (said he), I should not dislike the soup, but I have no appetite for the meat; what then is to become of that?" At the time that he refused this nourishment, for fear of being obliged to give away two or three pounds of meat, there was tied round his neck a silken bag, which contained 800 assignats of 1000 livres each. At his outset in life, he drank a pint of beer which served him for supper, every night at a house much frequented, from which he carried home all the bottle corks he could come at. Of these, in the course of eight years, he had collected as many as sold for 12 louis d'or, a sum that had laid the foundation of his future fortune, the superstructure of which was rapidly raised by his uncommon success in stock jobbing. He died possessed of three millions of livres (125,000l. sterling.)

2. The late John Elwes, Esq. was member for Berkshire in three successive parliaments. His family name was *Meggot;* and his father was a brewer of great eminence, and distinguished by no peculiarity of character: but his mother, though she was left nearly 100,000l. by her husband, starved herself to death! At an early period of life he was sent to Westminster school, where he remained for 10 or 12 years. During that time he certainly had not misapplied his talents; for he was a good classical scholar to the last: and it is a circumstance not a little remarkable, though well authenticated, that he never read afterwards, nor had he ever any knowledge in accounts; to which may in some measure be attributed the total ignorance he was always in as to his affairs. From Westminster school Mr Meggot removed to Geneva, where he soon entered upon pursuits more agreeable to him than study. The riding master of the academy there had then to boast perhaps of three of the best riders in Europe, Mr Worsley, Mr Elwes, and Sir Sidney Meadows. Of the three, Elwes was reckoned the most desperate; the young horses were always put into his hands, and he was the rough rider to the other two. Miser.

On his return to England, after an absence of two or three years, he was to be introduced to his uncle the late Sir Harvey Elwes, who was then living at Stoke in Suffolk, perhaps the most perfect picture of human penury that ever existed. The attempts at saving money were in him so extraordinary, that Mr Elwes perhaps never quite reached them, even at the last period of his life.—Of what temperance can do, Sir Harvey was an instance. At an early period of life he was given over for a consumption, and he lived till betwixt 80 and 90 years of age. On his death, his fortune, which was at least 250,000l. fell to his nephew Mr Meggot, who by will was ordered to assume the name and arms of Elwes. To this uncle, and this property, Mr Elwes succeeded when he had advanced beyond the 40th year of his age. For 15 years previous to this period, he was well known in the more fashionable circles of London. He had always a turn for play; and it was only late in life, and from paying always and not always being paid, that he conceived disgust at it. The theory which he professed, "that it was impossible to ask a gentleman for money," he perfectly confirmed by the practice; and he never violated this feeling to the latest hour of his life.

The manners of Mr Elwes were such—so gentle, so attentive, so gentlemanly, and so engaging—that rudeness could not ruffle them, or strong ingratitude break their observance. He retained this peculiar feature of the old court to the last; but he had a praise beyond this: He had the most gallant disregard of his own person, and all care about himself that can be imagined. The instances in younger life, in the most imminent personal hazard, are innumerable; but when age had despoiled him of his activity, and might have rendered care and attention about himself natural, he knew not what they were: He wished no one to assist him: "He was as young as ever; he could walk; he could ride, and he could dance; and he hoped he should not give trouble even when he was old:" He was at that time 75.

It is curious to remark how he contrived to mingle small attempts at saving with objects of the most unbounded dissipation. After sitting up a whole night at play for thousands with the most fashionable and profligate men of the time, amidst splendid rooms, gilt sofas, wax lights, and waiters attendant on his call, he would walk out about four in the morning, not towards home, but into Smithfield, to meet his own cattle, which were coming to market from Thaydonhall, a farm of his in Essex! There would this same man, forgetful of the scenes he had just left, stand in the cold or rain, bartering with a carcass butcher for a shilling! Sometimes when the cattle did not arrive at the hour he expected, he would walk on in the mire to meet them; and more than once has gone on foot the whole way to his farm without stopping, which was 17 miles from London, after sitting up the whole night. Had every man been of the mind of Mr Elwes, the race of innkeepers must have perished, and post-chaises have been returned back to those who made them; for it was the business of his life to avoid both. He always travelled on horseback. To see him setting out on a journey, was a matter truly curious; his first care was to put two or three eggs,

boiled

Miser.

boiled hard, into his great coat pocket, or any scraps of bread which he found; baggage he never took; then mounting one of his hunters, his next attention was to get out of London into that road where turnpikes were the fewest; then stopping under any hedge where grass presented itself for his horse, and a little water for himself, he would sit down and refresh himself and his horse together.

The chief residence of Mr Elwes at this period of his life was in Berkshire, at his own seat at Marcham. Here it was he had two natural sons born, who inherit the greatest part of his property by a will made about the year 1785. The keeping of fox-hounds was the only instance in the whole life of Mr Elwes of his ever sacrificing money to pleasure; and may be selected as the only period when he forgot the cares, the perplexities, and the regret, which his wealth occasioned. But even here every thing was done in the most frugal manner. Scrub, in the Beaux Stratagem, when compared with Mr Elwes's huntsman, had an idle life of it. This famous huntsman might have fixed an epoch in the history of servants: for in a morning, getting up at four o'clock, he milked the cows; he then prepared breakfast for Mr Elwes or any friends he might have with him: then slipping on a green coat, he hurried into the stable, saddled the horses, got the hounds out of the kennel, and away they went into the field. After the fatigues of hunting, he refreshed himself by rubbing down two or three horses as quickly as he could; then running into the house to lay the cloth, and wait at dinner; then hurrying again into the stable to feed the horses—diversified with an interlude of the cows again to milk, the dogs to feed, and eight hunters to litter down for the night.

In the penury of Mr Elwes there was something that seemed like a judgment from heaven. All earthly comforts he voluntarily denied himself: he would walk home in the rain in London rather than pay a shilling for a coach; he would sit in wet clothes sooner than have a fire to dry them; he would eat his provisions in the last stage of putrefaction sooner than have a fresh joint from the butchers; and he wore a wig for above a fortnight, which his biographer * saw him pick up out of a rut in a lane where they were riding. This was the last extremity of laudable economy; for to all appearance it was the cast-off wig of some beggar!

* Mr Topham; from whose *Life of John Elwes, Esq.* the particulars of this article are extracted.

Mr Elwes had now resided about 13 years in Suffolk, when the contest for Berkshire presented itself on the dissolution of the parliament; and when, to preserve the peace of that county, he was nominated by Lord Craven. Mr Elwes, though he had retired from public business for some years, had still left about him some of the seeds of more active life, and he agreed to the proposal. It came farther enhanced to him, by the agreement, that he was to be brought in by the freeholders for nothing. All he did on the occasion was dining at the ordinary at Reading; and he got into parliament for 18 pence!

Though a new man, Mr Elwes could not be called a young member; for he was at this time nearly 60 years old when he thus entered on public life. But he was in possession of all his activity; and, preparatory to his appearance on the boards of St Stephen's Chapel, he used to attend constantly during the races and other public meetings all the great towns where his voters resided. At the different assemblies he would dance among the youngest to the last, after riding over on horseback, and frequently in the rain, to the place of meeting. A gentleman who was one night standing by, observed on the extraordinary agility of so old a man.—O! that is nothing (replied another); for Mr Elwes, to do this, rode 20 miles in the rain, with his shoes stuck into his boots and his bag-wig in his pocket."

Miser.

The honour of parliament made no alteration in the dress of Mr Elwes: on the contrary, it seemed at this time to have attained additional meanness; and nearly to have reached that happy climax of poverty, which has more than once drawn on him the compassion of those who passed by him in the street. For the speaker's dinners, however, he had one suit, with which the speaker in the course of the sessions became very familiar. The minister likewise was well acquainted with it; and at any dinner of opposition still was his apparel the same. The wits of the minority used to say, "that they had full as much reason as the minister to be satisfied with Mr Elwes, as he had the same habit with every body." At this period of his life Mr Elwes wore a wig. Much about the time when his parliamentary life ceased, that wig was worn out; so then, being older and wiser as to expence, he wore his own hair, which like his expences was very small.

All this time the income of Mr Elwes was increasing hourly, and his present expenditure was next to nothing; for the little pleasures he had once engaged in he had now given up. He kept no house, and only one old servant and a couple of horses: he resided with his nephew: his two sons he had stationed in Suffolk and Berkshire, to look after his respective estates: and his dress certainly was no expence to him; for had not other people been more careful than himself, he would not have had it even mended.

When he left London, he went on horseback to his country seats with his couple of hard eggs, and without once stopping upon the road at any house. He always took the most unfrequented road, and used every shift to avoid turnpikes. Marcham was the seat he now chiefly visited; which had some reason to be flattered with the preference, as his journey into Suffolk cost him only twopence-halfpenny, while that into Berkshire amounted to fourpence!

As Mr Elwes came into parliament without expence, he performed his duty as a member would have done in the pure days of our constitution. What he had not bought he never attempted to sell; and he went forward in that straight and direct path, which can alone satisfy a reflecting mind. Amongst the smaller memorials of the parliamentary life of Mr Elwes may be noted, that he did not follow the custom of members in general by sitting on any particular side of the house, but sat as occasion presented itself on either indiscriminately; and he voted much in the same manner, but never rose to speak. In his attendance at the house, he was always early and late; and he never left it for dinner, as he had accustomed himself to fasting, sometimes for 24 hours in continuance.

When he quitted parliament, he was, in the common phrase, "a fish out of water!" The style of Mr

Elwes's

Miser. Elwes's life had left him no domestic scenes to which he could retire—his home was dreary and poor—his rooms received no cheerfulness from fire; and while the outside had all the appearance of a "House to be Let," the inside was a desert; but he had his penury alone to thank for this, and for the want of all the little consolations which should attend old age, and smooth the passage of declining life. At the close of the spring of 1785, he wished again to visit, which he had not done for some years, his seat at Stoke. But then the journey was a most serious object to him. The famous old servaut was dead; all the horses that remained with him were a couple of worn-out brood mares; and he himself was not in that vigour of body in which he could ride 60 or 70 miles on the sustenance of *two boiled eggs*. The mention of a post chaise would have been a crime—"He afford a post chaise, indeed! where was he to get the money?" would have been his exclamation. At length he was carried into the country as he was carried into parliament, free of expence, by a gentleman who was certainly not quite so rich as Mr Elwes. When he reached Stoke—the seat of more active scenes, of somewhat resembling hospitality, and where his fox hounds had spread somewhat like vivacity around—he remarked, "he had expended a great deal of money once very foolishly; but that a man grew wiser by time."

The rooms at this seat, which were now much out of repair, and would have all fallen in but for his son John Elwes, Esq. who had resided there, he thought too expensively furnished, as worse things might have served. If a window was broken, there was to be no repair but that of a little brown paper, or that of piecing in a bit of broken glass; which had at length been done so frequently, and in so many shapes, that it would have puzzled a mathematician to say "what figure they described." To save fire, he would walk about the remains of an old greenhouse, or sit with a servant in the kitchen. During the harvest he would amuse himself with going into the fields to glean the corn on the grounds of his own tenants; and they used to leave a little more than common to please the old gentlemau, who was as eager after it as any pauper in the parish. In the advance of the season, his morning employment was to pick up any stray chip, bones, or other things, to carry to the fire, in his pocket—and he was one day surprised by a neighbouring gentleman in the act of pulling down, with some difficulty, a crow's nest for this purpose. On the gentleman wondering why he gave himself this trouble—"Oh, Sir, (replied old Elwes), it is really a shame that these creatures should do so. Do but see what waste they make! They don't care how extravagant they are!"

As no gleam of favourite passion, or any ray of amusement, broke through this gloom of penury, his insatiable desire of saving was now become uniform and systematic. He used still to ride about the country on one of these mares—but then he rode her very economically, on the soft turf, adjoining the road, without putting himself to the expence of shoes, as he observed, "The turf was so pleasant to a horse's foot!" And when any gentleman called to pay him a visit, and the boy who attended in the stables, was profuse enough to put a little hay before his horse, old Elwes would slily steal back into the stable, and take the hay very carefully away. That very strong appetite which Mr Elwes had in some measure restrained during the long sitting of parliament, he now indulged most voraciously, and on every thing he could find. To save, as he thought, the expence of going to a butcher, he would have a whole sheep killed, and so eat mutton to the—*end of the chapter*. When he occasionally had his river drawn, though sometimes horse loads of small fish were taken, not one would he suffer to be thrown in again; for he observed, "He should never see them again!" Game in the last state of putrefaction, and meat that *walked about his plate*, would he continue to eat, rather than have new things killed before the old provision was finished. With this diet—the *charnel house of sustenance*—his dress kept pace—equally in the last stage of *absolute dissolution*. Sometimes he would walk about in a tattered brown-coloured hat, and sometimes in a red and white woollen cap, like a prisoner confined for debt. His shoes he never would suffer to be cleaned, lest they should be worn out the sooner. But still, with all this *self-denial*—that penury of life to which the inhabitant of an *alms house* is not doomed—still did he think he was profuse, and frequently say, "He must be a little more careful of his property." His disquietude on the subject of money was now continual. When he went to bed, he would put five or ten guineas into a bureau; and then, full of his money, after he had retired to rest, and sometimes in the middle of the night, he would come down to see if it was there. Miser.

The scene of mortification at which Mr Elwes was now arrived was all but a denial of the common necessaries of life; and indeed it might have admitted a doubt, whether or not, if his manors, his fish ponds, and some grounds in his own hands, had not furnished a subsistence, where he had not any thing *actually to buy*, he would not, rather than have *bought any thing*, have starved. Strange as this may appear, it is not exaggerated.—He one day, during this period, dined upon the remaining part of a moor hen, which had been brought out of the river by a *rat!* and at another ate an undigested part of a pike which a larger one had swallowed, but had not finished, and which were taken in this state in a net. At the time this last circumstance happened, he discovered a strange kind of satisfaction; for he said to a friend, "Aye! this was killing two birds with one stone!" In the room of all comment—of all moral—let it be remarked, that at this time Mr Elwes was perhaps worth nearly *eight hundred thousand pounds!* and, at this period, he had not made his will, of course was not saving from any sentiment of affection for any person.

The summer of 1788 Mr Elwes passed at his house in Welbeck street, London; and he passed that summer without any other society than that of two maid servants; for he had now given up the expence of keeping any male domestic. His chief employment used to be that of getting up early in a morning to visit some of his houses in Mary-le-bone, which during the summer were repairing. As he was there generally at four o'clock in a morning, he was of course on the spot before the workmen; and he used contentedly to sit down on the steps before the door, to scold them

Miser. them when they did come. The neighbours who used to see him appear thus regularly every morning, and who concluded, from his apparel, that he was one of the workmen, observed, "there never was so punctual a man as the old carpenter." During the whole morning he would continue to run up and down stairs to see the men were not idle for an instant, with the same anxiety as if his whole happiness in life had been centered in the finishing of this house, regardless of the greater property he had at stake in various places, and for ever employed in the *minutiæ* only of affairs. Indeed such was his anxiety about this house, the rent of which was not above 50l. a-year, that it brought on a fever which nearly cost him his life: but the fate which dragged him on thus strangely to bury him under the load of his own wealth, seemed as resistless as it was unaccountable.

In the muscular and unencumbered frame of Mr Elwes there was every thing that promised extreme length of life; and he lived to above 70 years of age without any natural disorder attacking him: but, as Lord Bacon has well observed, "the minds of some men are a lamp that is continually burning;" and such was the mind of Mr Elwes. Removed from those occasional public avocations which had once engaged his attention, money was now his only thought. He rose upon money—upon money he lay down to rest; and as his capacity sunk away from him by degrees, he dwindled from the real cares of his property into the puerile concealment of a few guineas. This little store he would carefully wrap up in various papers, and depositing them in different corners, would amuse himself with running from one to the other, to see whether they were all safe. Then forgetting, perhaps, where he had concealed some of them, he would become as seriously afflicted as a man might be who had lost all his property. Nor was the day alone thus spent—he would frequently rise in the middle of the night, and be heard walking about different parts of the house, looking after what he had thus hidden and forgotten.

During the winter of 1789, the last winter Mr Elwes was fated to see, his memory visibly weakened every day; and from the unceasing wish to save money, he now began to fear he should die in want of it. Mr Gibson had been appointed his builder in the room of Mr Adams; and one day, when this gentleman waited upon him, he said with apparent concern, "Sir, pray consider in what a wretched state I am: you see in what a good house I am living; and here are five guineas, which is all I have at present; and how I shall go on with such a sum of money puzzles me to death. I dare say you thought I was rich; now you see how it is!"

Mr George Elwes having now settled at his seat at Marcham in Berkshire, he was naturally desirous that, in the assiduities of his wife, his father might at length find a comfortable home. In London he was certainly most uncomfortable: but still, with these temptations before and behind him, a journey with any expence annexed to it was insurmountable. This, however, was luckily obviated by an offer from Mr Partis, a gentleman of the law, to take him to his ancient seat in Berkshire with his purse perfectly whole. But there was one circumstance still very distressing—the old gentleman had now nearly worn out his last coat, and he would not buy a new one; his son, therefore, with a pious fraud, contrived to get Mr Partis to buy him a coat and make him a present of it. Thus formerly having had a good coat, then a bad one, and at last no coat at all, he was kind enough to accept one from a neighbour. Miser || Misfeasance.

Mr Elwes carried with him into Berkshire five guineas and a half, and half a crown. Lest the mention of this sum may appear singular, it should be said, that previous to his journey he had carefully wrapped it up in various folds of paper, that no part of it might be lost. On the arrival of the old gentleman, Mr George Elwes and his wife did every thing they could to make the country a scene of quiet to him. But "he had that within" which baffled every effort of this kind. Of his heart it might be said, "there was no peace in Israel." His mind, cast away upon the vast and troubled ocean of his property, extending beyond the bounds of his calculation, returned to amuse itself with fetching and carrying about a few guineas, which in that ocean was indeed a drop. But nature had now carried on life nearly as far as she was able, and the sand was almost run out. The first symptom of more immediate decay was his inability to enjoy his rest at night. Frequently would he be heard at midnight as if struggling with some one in his chamber, and crying out, "I will keep my money, I will; nobody shall rob me of my property." On any one of the family going into his room, he would start from this fever of anxiety, and, as if waking from a troubled dream, again hurry into bed, and seem unconscious of what had happened. At length, on the 26th November 1789, expired this miserably rich man, whose property, nearly reaching to a million, extended itself almost through every county in England.

MISERICORDIA, in *Law*, is an arbitrary fine imposed on any person for an offence; this is called *misericordia*, because the amercement ought to be but small, and less than that required by magna charta. If a person be outrageously amerced in a court that is not of record, the writ called *moderata misericordia* lies for moderating the amercement according to the nature of the fault.

MISFORTUNE. An unlucky accident.

Misfortune, or chance, in *Law*, a deficiency of the will; or committing of an unlawful act by misfortune or chance, and not by design. In such case, the will observes a total neutrality, and does not co-operate with the deed; which therefore wants one main ingredient of a crime. See Crime.

Of this, when it affects the life of another, we have spoken under the article Homicide; and in this place have only occasion to observe, that if any accidental mischief happens to follow from the performance of a lawful act, the party stands excused from all guilt: but if a man be doing any thing unlawful, and a consequence ensues which he did not foresee or intend, as the death of a man or the like, his want of foresight shall be no excuse; for, being guilty of one offence, in doing antecedently what is in itself unlawful, he is criminally guilty of whatever consequence may follow the first misbehaviour.

MISFEASANCE, in law books, signifies a trespass.

Misletoe || Misprisions.

MISLETOE. See VISCUM, BOTANY *Index*.

MISNOMER, in *Law*, a misnaming or mistaking a person's name. The Christian name of a person should always be perfect; but the law is not so strict in regard to surnames, a small mistake in which will be dispensed with to make good a contract, and support the act of the party. See PLEA *to Indictment*.

MISPRISIONS, (a term derived from the old French, *mespris*, a neglect or contempt), are, in the acceptation of our law, generally understood to be all such high offences as are under the degree of capital, but nearly bordering thereon: and it is said, that a misprision is contained in every treason and felony whatsoever; and that, if the king so please, the offender may be proceeded against for the misprision only. And upon the same principle, while the jurisdiction of the star-chamber subsisted, it was held that the king might remit a prosecution for treason, and cause the delinquent to be censured in that court, merely for a high misdemeanor; as happened in the case of Roger earl of Rutland, in 43 Eliz. who was concerned in the earl of Essex's rebellion. Misprisions are generally divided into two sorts; negative, which consist in the concealment of something which ought to be revealed; and positive, which consist in the commission of something which ought not to be done.

1. Of the first, or negative kind, is what is called *misprision of treason*; consisting in the bare knowledge and concealment of treason, without any degree of assent thereto; for any assent makes the party a principal traitor; as indeed the concealment, which was construed aiding and abetting, did at the common law; in like manner as the knowledge of a plot against the state, and not revealing it, was a capital crime at Florence, and other states of Italy. But it is now enacted by the statute 1 & 2 Ph. & Mar. c. 10. that a bare concealment of treason shall be only held a misprision. This concealment becomes criminal, if the party apprised of the treason does not, as soon as conveniently may be, reveal it to some judge of assize or justice of the peace. But if there be any probable circumstances of assent, as if one goes to a treasonable meeting, knowing beforehand that a conspiracy is intended against the king; or, being in such company once by accident, and having heard such treasonable conspiracy, meets the same company again, and hears more of it, but conceals it; this is an implied assent in law, and makes the concealer guilty of actual high treason.

Misprision of felony is also the concealment of a felony which a man knows, but never assented to; for, if he assented, this makes him either principal or accessory. And the punishment of this, in a public officer, by the statute Westm. 1. 3 Edw. I. c. 9. is imprisonment for a year and a day; in a common person, imprisonment for a less discretionary time; and, in both, fine and ransom at the king's pleasure: which pleasure of the king must be observed, once for all, not to signify any extrajudicial will of the sovereign, but such as is declared by his representatives, the judges in his courts of justice; *voluntas regis in curia, non in camera*.

2. Misprisions, which are merely positive, are generally denominated *contempt* or *high misdemeanours*; of which the principal is the *mal-administration* of such high officers as are in public trust and employment. This is usually punished by the method of parliamentary impeachment; wherein such penalties, short of death, are inflicted, as to the wisdom of the house of peers shall seem proper; consisting usually of banishment, imprisonment, fines, or perpetual disability. Hither also may be referred the offence of *embezzling the public money*, called among the Romans *peculatus*; which the Julian law punished with death in a magistrate, and with deportation, or banishment, in a private person. With us it is not a capital crime, but subjects the committer of it to a discretionary fine and imprisonment.—Other misprisions are, in general, such contempts of the executive magistrate as demonstrate themselves by some arrogant and undutiful behaviour towards the king and government: for a detail of which, *vide* Blackstone's Comment. iv. 22.

Misprisions || Mississippi.

MISSAL, the Romish mass-book, containing the several masses to be said on particular days. It is derived from the Latin word *missa*, which, in the ancient Christian church, signified every part of divine service.

MISSEL-BIRD, a species of TURDUS. See TURDUS, ORNITHOLOGY *Index*.

MISSIO, among the Romans, was a full discharge given to a soldier after 20 years service, and differed from the *exauctoratio*, which was a discharge from duty after 17 years service. Every soldier had a right to claim his *missio* at the end of 20 years.

MISSION, in *Theology*, denotes a power or commission to preach the gospel. Jesus Christ gave his disciples their mission in these words, *Go and teach all nations*, &c. The Romanists reproach the Protestants, that their ministers have no mission, as not being authorized in the exercise of their ministry, either by an uninterrupted succession from the apostles, or by miracles, or by any extraordinary proof of a vocation. Many among us deny any other mission necessary for the ministry than the talents necessary to discharge it.

MISSION is also used for an establishment of people zealous for the glory of God and the salvation of souls; who go and preach the gospel in remote countries and among infidels.

MISSIONARY, an ecclesiastic who devotes himself and his labours to some mission, either for the instruction of the orthodox, the conviction of heretics, or the conversion of infidels. See JESUITS.

MISSISSIPPI, a river of North America, and one of the largest in the world. It rises in some lakes about the latitude of 48°, and runs in a direction nearly south to the gulf of Mexico. Its course, including windings, is about 2500 miles in length, and it is navigable from the sea to the falls of St Anthony in latitude 44° 50′. Its width is from 800 yards to a mile and a half. Its depth above New Orleans has been found to be 150 feet; but there is only from 12 to 17 feet water on the bars at its mouth. Its current is from three to four miles an hour, but varies with the rise and fall of the waters. In low water a boat will float down at the rate of 45 or 50 miles a day, and in high water at 90 or 100. Towards the mouth the current is much less rapid than farther up. The usual progress of a boat up the river is about 15 miles a day; but the steam-boats, of which there are now great num-

Mississippi, Missouri.

bers on this river, go against the stream at the rate of 60 miles a-day. This river has an annual swell, which begins in November, and increases till May, from which period it again diminishes till October. The greatest rise from the mouth of the Ohio to Natchez is about 50 feet; but at New Orleans is only about 12 feet. During this annual flood a part of the waters pass over the western banks, inundate the country to a considerable extent, and never return into the bed of the river, but either form marshes, or pass off to the sea by different channels. In the lower part of its course the banks are higher than the surrounding country; and, besides the waters that overflow during the floods, a part always escapes by lateral branches, which intersect the country towards its mouth in various directions, and form a delta about 200 miles long by 100 broad. This tract, inclosed within the branches of the river, is, for the greater part, a morass nearly on a level with high water. It has evidently been formed by alluvial matter brought down and deposited by the river, and it is observed to be continually enlarging.

The Mississippi receives in its course a great many very large rivers, the Illinois and Ohio on the east; the Missouri, Arkansaw, Red River, &c. on the west. Including all its branches, Mr Bradbury computes that it waters a country eleven times as large as Great Britain and Ireland.

Mississippi, one of the United States of North America, is situated on the east side of the river of the same name, between 30° and 35° N. Lat. and 87° and 91° W. Long. It is about 350 miles long, and 150 broad, and has an area of about 45,000 square miles. The southern parts on the gulf of Mexico are low, sandy, or marshy, and unhealthy; but the middle and northern parts are pretty well watered, and very fertile. The great articles of culture are cotton and Indian corn; rice and sugar, however, are also raised. Lemons and other fruits thrive well. Horned cattle are raised in great numbers, but are sometimes destroyed by the wolf and cougouar. Labour is generally performed by slaves. Natchez, the principal town, and the only place of trade, is about 300 miles above New Orleans. There are some tanneries in the state, and some domestic manufactures of woollen, cotton, flax, and hemp. The principal rivers are the Tombigbee, Pascagoula, Pearl, and Yazoo. This state was admitted into the Union in 1817. Its population the year before was 44,206, of whom 20,567 were slaves, and 191 free blacks. The Choctaws, Cherokees, and some other of the Indian tribes who have made considerable advances in civilization, reside in this state. The legislative power of this state is vested in a house of representatives and a senate, chosen by all free white males of 21 years of age.

MISSOURI, a river in Louisania, which falls into the Mississippi from the west, 195 miles above the mouth of the Ohio, and about 1160 miles from the Balize in the gulf of Mexico. Though the united rivers take the name of the Mississippi, the Missouri is much the largest branch. It was first explored by Captains Lewis and Clerk in 1804, 1805, and 1806. It is navigable for boats to the great falls 2848 miles from its junction with the Mississippi, and even beyond this almost to its source at the distance of 3096 miles from the Mississippi, making the total extent of navigation from the sea in one line above 4000 miles. Its width varies from 200 yards to a mile. Its velocity was found by the log to be about five miles an hour. It receives many large streams, the Yellowstone, Kansas, Platte, &c. chiefly on its south side; and it is computed that, including these branches, it affords an inland navigation of 15,000 miles. It carries down great quantities of earth, and has an annual swell like the Mississippi. Its sources in the Stony mountains are not far from those of the Columbia, which flows into the Pacific ocean. The distance to the South sea from the Mississippi by this route is 3555 miles.

Missouri || Mite.

Missouri, a territory of the United States of North America, including the greater part of the country formerly known under the name of Louisiana. It extends from the Mississippi to the Rocky mountains, and from the gulf of Mexico to Canada. Its length from north to south is about 1400 miles, and its breadth from east to west 886, comprising an area of 985,250 square miles. It is watered by the Missouri river and its numerous tributary streams, and by some other branches of the Mississippi. The surface is generally uneven, but not mountainous. The soil is rich and well watered; but, unlike that of the eastern parts of America, it produces little natural wood, except on the banks of the rivers. Lime is abundant in this vast region; coal and iron ore were observed in many places; and salt is found in great quantities. Near St Louis lead ore abounds, and is wrought to a great extent. As the country extends through 20 degrees of latitude, the climate is various; warm and unhealthy in the south; colder and more salubrious towards the north. There are as yet but a small number of white settlers in this country, the greater part of which is still occupied by savage tribes.

MISSUS, in the Circensian games, were the matches in horse or chariot races. The usual number of *missus* or matches in one day was 24; though the emperor Domitian presented the people with 100. The last match was generally made at the expence of the people, who made a collection for the purpose; hence it was called *missus ærarius*, a subscription plate.

MIST, or Fog. See Fog.

MISTAKE, any wrong action committed, not through an evil design, but through an error of judgment.

MISUSER, in *Law*, is an abuse of any liberty or benefit; as "He shall make fine for his misuser." Old. Nat. Br. 149. By misuser a charter of a corporation may be forfeited; so also an office, &c.

MITCHELSTOWN, a post town of Ireland, in the county of Cork and province of Munster in Ireland, where there is a college founded by the earl of Kingston for the support of 12 decayed gentlemen and 12 decayed gentlewomen, who have 40l. yearly, and handsome apartments.

MITE, a small piece of money mentioned Luke xii. 59. and xxi. 2. In the Greek it is κοδράντης, i. e. *quadrans*, or a quarter of the Roman *denarius*; so that the mite was worth about seven farthings, or twopence of our money.

Mite. See Acarus, Entomology *Index*.

Mitella || Mithridates.

MITELLA, Bastard American Sanicle; a genus of plants belonging to the decandria class, and in the natural method ranking under the 13th order, *Succulentæ*. See Botany *Index*.

MITHRA, feasts of, in antiquity, were feasts celebrated among the Romans in honour of Mithras or the sun. The most ancient instance of this Mithras among the Romans occurs in an inscription dated in the third consulate of Trajan, or about the year of Christ 101. This is the dedication of an altar to the sun under the above name, thus inscribed, *Deo Soli Mithræ*. But the worship of Mithras was not known in Egypt and Syria in the time of Origen, who died about the year of Christ 263; though it was common at Rome for more than a century before this time. The worship of Mithras was proscribed at Rome in the year 378, by order of Gracchus, prefect of the prætorium. According to M. Freret, the feasts of Mithras were derived from Chaldea, where they had been instituted for celebrating the entrance of the sun into the sign Taurus.

MITHRAS, or Mithra, a god of Persia and Chaldea, supposed to be the sun. His worship was introduced at Rome. He is generally represented as a young man, whose head is covered with a turban after the manner of the Persians. He supports his knee upon a bull that lies on the ground, and one of whose horns he holds in one hand, while with the other he plunges a dagger in his neck.

MITHRIDATE, an old term, in *Pharmacy*; an antidote or composition, in form of an electuary, supposed to serve either as a remedy or a preservative against poisons; so named from the inventor, Mithridates, king of Pontus, who is said to have so fortified his body against poisons with antidotes and preservatives, that when he had a mind to dispatch himself he could not find any poison that would take effect.

MITHRIDATES, the name of several kings of Pontus. See Pontus.

Mithridates VII. surnamed *Eupator* and *the Great*, succeeded to the throne at the age of 11 years, about 123 years before the Christian era. The beginning of his reign was marked by ambition, cruelty, and artifice. He murdered his own mother, who had been left by his father co-heiress of the kingdom; and he fortified his constitution by drinking antidotes against the poison with which his enemies at court attempted to destroy him. He early inured his body to hardship, and employed himself in the most manly exercises, often remaining whole months in the country, and making frozen snow and the earth the place of his repose. Naturally ambitious and cruel, he spared no pains to acquire himself power and dominion. He murdered the two sons whom his sister Laodice had by Ariarathes king of Cappadocia, and placed one of his own children, only eight years old, on the vacant throne. These violent proceedings alarmed Nicomedes king of Bithynia, who had married Laodice the widow of Ariarathes, and ultimately involved Mithridates in a quarrel with the Romans. Mithridates never lost an opportunity by which he might lessen the influence of his adversaries; and the more effectually to destroy their power in Asia, he ordered all the Romans that were in his dominions to be massacred. This was done in one night, and no less than 150,000, according to Plutarch, or 80,000 Romans, as Appian mentions, were made the victims of his cruelty. This called aloud for vengeance. Aquilius, and soon after Sylla, marched against Mithridates with a large army. The former was made prisoner; but Sylla obtained a victory over the king's generals; and another decisive engagement rendered him master of all Greece, Macedonia, Ionia, and Asia Minor. This ill fortune was aggravated by the loss of about 200,000 men, who were killed in the several engagements that had been fought; and Mithridates, weakened by repeated ill success by sea and land, sued for peace from the conqueror, which he obtained on hard terms. But he soon took the field again with an army of 140,000 infantry, and 16,000 horse, consisting of his own forces and those of his son-in-law Tigranes king of Armenia. With this army he made himself master of the Roman provinces in Asia; none dared to oppose his conquests; and the Romans, relying on his fidelity, had withdrawn the greatest part of their armies from the country. The news of his warlike preparations were no sooner heard, than Lucullus the consul marched into Asia; and without delay he blocked up the camp of Mithridates who was then besieging Cyzicus. The Asiatic monarch escaped from him, and fled into the heart of his kingdom. Lucullus pursued him with the utmost celerity; and would have taken him prisoner after a battle, had not the avidity of his soldiers preferred the plundering of a mule loaded with gold to the taking of a monarch who had exercised such cruelties against their countrymen. The appointment of Glabrio to the command of the Roman forces, instead of Lucullus, was favourable to Mithridates, who recovered the greatest part of his dominions. The sudden arrival of Pompey, however, soon put an end to his victories. A battle in the night was fought near the Euphrates. An universal overthrow ensued, and Mithridates, bold in his misfortunes, rushed through the thick ranks of the enemy at the head of 800 horsemen, 500 of whom perished in the attempt to follow him. He fled to Tigranes; but that monarch refused an asylum to his father-in-law, whom he had before supported with all the collected forces of his kingdom. Mithridates found a safe retreat among the Scythians; and though destitute of power, friends, and resources, yet he meditated the overthrow of the Roman empire, by penetrating into the heart of Italy by land. These wild projects were rejected by his followers, and he sued for peace. It was denied to his ambassadors; and the victorious Pompey declared, that, to obtain it, Mithridates must ask it in person. He scorned to trust himself in the hands of his enemy, and resolved to conquer or to die. His subjects refused to follow him any longer; and revolting from him, made his son Pharnaces king. The son showed himself ungrateful to his father; and even, according to some writers, he ordered him to be put to death. This unnatural treatment broke the heart of Mithridates; he obliged his wife to poison herself, and attempted to do the same himself. It was in vain: the frequent antidotes he had taken in the early part of his life, strengthened his constitution against the poison; and when this was unavailing, he attempted to stab himself. The blow was not mortal; and a Gaul who was then present, at his own request, gave him the fatal stroke, about 64 years before the Christian era. Such were the misfortunes, abilities, and miserable end, of a man, who

Mithridates.

Mithridates || Mittimus.

supported himself so long against the power of Rome, and who, according to the declarations of the Roman authors, proved a more powerful and indefatigable adversary to the capital of Italy than the great Hannibal, Pyrrhus, Perseus, or Antiochus. It is said that Mithridates conquered 24 nations, whose different languages he knew and spoke with the same ease and fluency as his own. As a man of letters he also deserves attention. He was acquainted with the Greek language, and even wrote in that dialect a treatise on botany. His skill in physic is well known; and even now there is a celebrated antidote which bears his name, and is called *mithridate*.

MITRA, was a cap or covering for the head, worn by the Roman ladies, and sometimes by the men; but it was looked upon as a mark of effeminacy in the last, especially when it was tied upon their heads.

MITRE, a sacerdotal ornament worn on the head, by bishops and certain abbots on solemn occasions; being a sort of cap, pointed and cleft at top. The high priest among the Jews wore a mitre or bonnet on his head. The inferior priests of the same nation had likewise their mitres; but in what respect they differed from that of the high priest, is uncertain. Some contend that the ancient bishops wore mitres; but this is by no means certain.

MITRE, in *Architecture*, is the workmen's term for an angle that is just 45 degrees, or half a right one. If the angle be a quarter of a right angle, they call it a *half mitre*.

To describe such angles, they have an instrument called the *mitre square*; with this they strike mitre lines on their quarters or battens; and for despatch, they have a *mitre box*, as they call it, which is made of two pieces of wood, each about an inch thick, one nailed upright on the edge of the other; the upper piece hath the mitre lines struck upon it on both sides, and a kerf to direct the saw in cutting the mitre joints readily, by only applying the piece into this box.

MITRE is used by the writers of the Irish history for a sort of base money, which was very common there about the year 1270, and for 30 years before and as many after.

There were besides the mitre several other pieces, called, according to the figures impressed upon them, rosaries, lionades, eagles, and by the like names. They were imported from France and other countries, and were so much below the proper currency of the kingdom, that they were not worth so much as a halfpenny each. They were at length decryed in the year 1300, and good coins struck in their place. These were the first Irish coins in which the sceptre was left out. They were struck in the reign of Edward, the son of our Henry III. and are still found among the other antiquities of that country. They have the king's head in a triangle full faced. The penny, when well preserved, weighs 22 grains; the halfpenny 10½ grains.

MITTAU, the capital of the duchy of Courland. It is strongly fortified; but was taken by the Swedes in 1701, and by the Muscovites in 1706. E. Long. 23. 51. N. Lat. 56. 44.

MITTIMUS, as generally used, hath two significations. 1. It signifies a writ for removing or transferring of records from one court to another. 2. It signifies a precept, or command in writing, under the hand and seal of a justice of the peace, directed to the gaoler or keeper of some prison, for the receiving and safe keeping of an offender charged with any crime, until he be delivered by due course of law. Mittimus || Moab

MITYLENE, or MYTELENE, in *Ancient Geography*, a celebrated, powerful, and affluent city, capital of the island of Lesbos. It received its name from *Mitylene*, the daughter of Macareus, a king of the country. It is greatly commended by the ancients for the stateliness of its buildings and the fruitfulness of its soil, but more particularly for the great men it produced: Pittacus, Alcæus, Sappho, Terpander, Theophanes, Hellanicus, &c. were all natives of Mitylene. It was long a seat of learning; and, with Rhodes and Athens, it had the honour of having educated many of the great men of Rome and Greece. In the Peloponnesian war, the Mitylenians suffered greatly for their revolt from the power of Athens; and in the Mithridatic wars, they had the boldness to resist the Romans, and disdain the treaties which had been made between Mithridates and Sylla. See METELIN.

MIXT, or MIXT BODY, in *Chemistry*, that which is compounded of different elements or principles.

MIXTURE, a compound or assemblage of several different bodies in the same mass. Chemical mixture is attended with many phenomena which are never observed in simple mixtures; such as heat, effervescence, &c. To chemical mixture belong the union of acids and alkalies, the amalgamation of metals, solution of gums, &c. and upon it depend many of the principal operations of CHEMISTRY. See that article, *passim*.

MIXTURE, in *Pharmacy*, a medicine which differs from a julep in this respect, that it receives into its composition not only salts, extracts, and other substances dissoluble in water; but also earths, powders, and such substances as cannot be dissolved.

MIZEN, in the sea language, is a particular mast or sail. The mizen mast stands in the sternmost part of the ship. In some great ships there are two of these; when that next the main-mast is called the *main-mizen*, and that next the poop the *bonaventure mizen*.

MIZRAIM, or MISRAIM, the dual name of Egypt, used in Scripture to denote the Higher and Lower Egypt, which see. It sometimes occurs singular, *Mazor*: 2 Kings xix. Isaiah xix. Micah vii.

MNEMOSYNE, in fabulous history, a daughter of Cœlus and Terra. She married Jupiter, by whom she had the nine Muses. The word *mnemosyne* signifies "memory;" and therefore the poets have rightly called Memory the mother of the Muses, because it is to that mental endowment that mankind are indebted for their progress in science.

MNIUM, MARSHMOSS; a genus of the natural order of musci, belonging to the cryptogamia class of plants. See BOTANY *Index*.

MOAB, in *Ancient Geography*, a country of Arabia Petræa; so called from Moab the son of Lot, to whose posterity this country was allotted by divine appointment, Deut. xi. 9. It was originally occupied by the Emim, a race of giants extirpated by the Moabites, *ibid.* Moab anciently lay to the south of Ammon, before Sihon the Amorite stripped both nations of a part of their territory, afterwards occupied by the Israelites, Numb. xxi.; and then Moab was bounded by the river Arnon to the north, the Lacus Asphaltites to the west, the

Moab || Mocho.

the brook Zared to the south, and the mountains Abarim to the east.

MOAT, or DITCH, in *Fortification*, a deep trench dug round the rampart of a fortified place, to prevent surprises.

The brink of the moat, next the rampart, is called the *scarpe;* and the opposite one, the *counterscarpe*.

A dry moat round a large place, with a strong garrison, is preferable to one full of water; because the passage may be disputed inch by inch, and the besiegers, when lodged in it, are continually exposed to the bombs, grenades, and other fire works, which are thrown incessantly from the rampart into their works. In the middle of dry moats, there is sometimes another small one, called *cunette;* which is generally dug so deep till they find water to fill it.

The deepest and broadest moats are accounted the best; but a deep one is preferable to a broad one: the ordinary breadth is about 20 fathoms, and the depth about 16.

To drain a moat that is full of water, they dig a trench deeper than the level of the water, to let it run off; and then throw hurdles upon the mud and slime, covering them with earth or bundles of rushes, to make a sure and firm passage.

MOATAZALITES, or SEPARATISTS, a religious sect among the Turks, who deny all forms and qualities in the Divine Being; or who divest God of his attributes.

There are two opinions among the Turkish divines concerning God. The first admits metaphysical forms or attributes; as, that God has wisdom, by which he is wise; power, by which he is powerful; eternity, by which he is eternal, &c. The second allows God to be wise, powerful, eternal; but will not allow any form or quality in God, for fear of admitting a multiplicity. Those who follow this latter opinion are called *Moatazalites;* they who follow the former, *Sephalites*.

This sect is said to have first invented the scholastic divinity, and is subdivided into no less than 20 inferior sects, which mutually brand one another with infidelity.

MOBILE, a town in the United States, in the territory of Alabama, situated on a bay of the same name in the gulf of Mexico. It has but an indifferent port. Its population in 1817, was from 1000 to 1500 persons.

MOBILE, *Moveable*, any thing susceptible of motion, or that is disposed to be moved either by itself or by some other prior *mobile* or mover.

Primum Mobile, in the ancient astronomy, was a ninth heaven or sphere, imagined above those of the planets and fixed stars. This was supposed to be the first mover, and to carry all the lower spheres round along with it; by its rapidity communicating to them a motion whereby they revolved in 24 hours. But the diurnal revolution of the planets is now accounted for without the assistance of any such *primum mobile*.

Perpetuum Mobile. See *Perpetual Motion*.

MOCHO, MOCO, or *Mokha;* by some supposed to be the Musa or Muza of Ptolemy, is a port and town on the Red Sea, of considerable trade; contains about 10,000 inhabitants, Jews, Armenians, and Mohammedans; and it gives name to a kingdom extending along the most southern coast of Arabia; of which that part which lies next the sea is a dry barren desert, in some places 10 or 12 leagues over; but bounded by mountains, which being well watered, enjoy an almost perpetual spring; and besides coffee, the peculiar produce of this country, yields corn, grapes, myrrh, frankincense, cassia, balm, gums of several sorts, mangos, dates, pomegranates, &c. The weather here is so hot and sultry in summer, especially when the south wind blows, that it would be insupportable, if it was not mitigated by the cool breezes that generally blow from the mountains on the north, or the Red and Arabic seas on the west and east. The heat in winter is equal to that of our warmest summers; and it is very seldom that either clouds or rain are seen. The city of Mocho is now the emporium for the trade of all India to the Red sea. The trade was removed hither from Aden, in consequence of the prophecy of a sheik, much revered by the people, who foretold that it would soon become a place of extensive commerce notwithstanding its disadvantageous situation. The buildings here are lofty, and tolerably regular, having a pleasant aspect from Mecca. The steeples of several mosques are very high, presenting themselves to view at a great distance. Their markets are well stored with beef, mutton, lamb, kid, camels and antelopes flesh, common fowls, Guinea hens, partridges, and pigeons. The sea affords plenty of fish, but not savoury; which some think proceeds from the extreme saltness of the water and the nature of their aliment. The markets are also stocked with fruit, such as grapes, peaches, apricots, quinces, and nectarines; although neither shrub nor tree is to be seen near the town, except a few date trees. Frequently no rain falls here in two or three years, and seldom more than a shower or two in a year; but in the mountains, at the distance of about 20 miles from Mocha, the earth is watered with a gentle shower every morning, which makes the valleys fertile in corn and the fruits natural to the climate. The Arab inhabitants, though remarkably grave and superstitious, are said to be extremely covetous and hypocritical; robbing, thieving, and committing piracy, without the least scruple or remorse. The English and Dutch companies have handsome houses here, and carry on a great trade in coffee, olibanum, myrrh, aloes, liquid storax, white and yellow arsenic, gum arabic, mummy, balm of Gilead, and other drugs. One inconvenience, however, they sustain from the violence and exactions of the Arabian princes; but the king's customs are easy, being fixed at three per cent. to Europeans. Of the coins at Mocha, the most current is the camassie, which rises and falls in value at the banker's discretion: they are from 50 to 80 for a current dollar, which is but an imaginary species, being always reckoned one and a half per cent. lower than Spanish dollars.

Mocho || Mode.

MOCKING BIRD. See TURDUS, ORNITHOLOGY *Index*.

MOCOCO. See LEMUR, MAMMALIA *Index*.

MODE, which is a word of the same general import with MANNER, is used as a technical term in grammar, metaphysics, and music. For its import in GRAMMAR, see that article, N° 80.

MODE, in *Metaphysics*, seems properly to denote the manner of a thing's existence: but Locke, whose language

Mode, Model.

language in that science is generally adopted, uses the word in a sense somewhat different from its ordinary and proper signification. "Such complex ideas, which, however compounded, contain not in them the supposition of subsisting by themselves, but are considered as dependencies on, or affections of, substances," he calls *modes*. Of these *modes*, there are, according to him, two sorts, which deserve distinct consideration. First, There are some "which are only variations, or different combinations of the same simple idea, without the mixture of any other, as *a dozen* or *a score*; which are nothing but the ideas of so many distinct units added together:" and these he calls *simple modes*. Secondly, "There are others compounded of simple ideas of several kinds put together to make one complex one; v. g. *beauty*, consisting of a certain composition of colour and figure, causing delight in the beholder; *theft*, which being the concealed change of the possession of any thing without the consent of the proprietor, contains, as is visible, a combination of several ideas of several kinds;" and these he calls *mixed modes*. For the just distinction between *ideas* and *notions*, as well as between *ideas* and the *qualities* of external objects, which in this account of modes are all confounded together, see METAPHYSICS.

MODE, in *Music*, a regular disposition of the air and accompaniments, relative to certain principal sounds upon which a piece of music is formed, and which are called the *essential sounds of the mode*.

Our *modes* are not, like those of the ancients, characterized by any sentiment which they tend to excite, but result from our system of harmony alone. The sounds essential to the mode are in number three, and form together one perfect chord. 1. The tonic or key, which is the fundamental note both of the tone and of the mode. 2. The dominant, which is a fifth from the tonic. 3. The mediant, which properly constitutes the *mode*, and which is a third from the same tonic. As this third may be of two kinds, there are of consequence two different modes. When the mediant forms a greater third with the tonic, the mode is major; when the third is lesser, it is minor. See MUSIC.

MODEL, in a general sense, an original pattern, proposed for any one to copy or imitate.

1 Different kinds of models.

This word is particularly used, in building, for an artificial pattern made in wood, stone, plaster, or other matter, with all its parts and proportions, in order for the better conducting and executing some great work, and to give an idea of the effect it will have in large. In all great buildings, it is much the surest way to make a model in relievo, and not to trust to a bare design or draught. There are also models for the building of ships, &c. and for extraordinary staircases, &c.

They also use models in painting and sculpture; whence, in the academies, they give the term *model* to a naked man or woman, disposed in several postures, to afford an opportunity to the scholars to design them in various views and attitudes.

2 General method of making models.

Models in imitation of any natural or artificial substance, are most usually made by means of moulds composed of plaster of Paris. For the purpose of making these moulds, this kind of plaster is much more fit than any other substance, on account of the power it has of absorbing water, and soon condensing into a hard substance, even after it has been rendered so thin as to be of the consistence of cream. This happens in a shorter or longer time as the plaster is of a better or worse quality; and its good or bad properties depend very much upon its age, to which, therefore, particular regard ought to be had. It is sold in the shops at very different prices; the finest being made use of for casts, and the middling sort for moulds. It may be very easily coloured by means of almost any kind of powder excepting what contains an alkaline salt; for this would chemically decompose the substance of it, and render it unfit for use. A very considerable quantity of chalk would also render it soft and useless, but lime hardens it to a great degree. The addition of common size will likewise render it much harder than if mere water is made use of. In making either moulds or models, however, we must be careful not to make the mixture too thick at first; for if this is done, and more water added to thin it, the composition must always prove brittle and of a bad quality. Model.

The particular manner of making models (or *casts*, as they are also called) depends on the form of the subject to be taken. The process is easy, where the parts are elevated only in a slight degree, or where they form only a right or obtuse angle with the principal surface from which they project; but where the parts project in smaller angles, or form curves inclined towards the principal surface, the work is more difficult. This observation, however, holds good only with regard to hard and inflexible bodies; for such as are soft may often be freed from the mould, even though they have the shape last mentioned. But though this be the case with the soft original substance, it is not so with the inflexible model when once it is cast.

The moulds are to be made of various degrees of thickness, according to the size of the model to be cast; and may be from half an inch to an inch, or, if very large, an inch and a half. Where a number of models are to be taken from one mould, it will likewise be necessary to have it of a stronger contexture than where only a few are required, for very obvious reasons.

3 Anatomical models.

It is much more easy to make a mould for any soft substance than a rigid one, as in any of the viscera of the animal body; for the fluidity of the mixture makes it easily accommodate itself to the projecting parts of the substance; and as it is necessary to inflate these substances, they may be very readily extracted again by letting out the air which distended them.

When a model is to be taken, the surface of the original is first to be greased, in order to prevent the plaster from sticking to it; but if the substance itself is slippery, as is the case with the internal parts of the human body, this need not be done: when necessary, it may be laid over with lintseed oil by means of a painter's brush. The original is then to be laid on a smooth table, previously greased or covered with a cloth, to prevent the plaster sticking to it; then surround the original with a frame or ridge of glaziers putty, at such a distance from it as will admit the plaster to rest upon the table on all sides of the subject for about an inch, or as much as is sufficient to give the proper degree of strength to the mould. A sufficient

Pole's Anatomical Instructor.

Model. cient quantity of plaster is then to be poured as uniformly as possible over the whole substance, until it be everywhere covered to such a thickness as to give a proper substance to the mould, which may vary in proportion to the size. The whole must then be suffered to remain in this condition till the plaster has attained its hardness; when the frame is taken away, the mould may be inverted, and the subject removed from it: and when the plaster is thoroughly dry let it be well seasoned.

Having formed and seasoned the moulds, they must next be prepared for the casts by greasing the inside of them with a mixture of olive oil and lard in equal parts, and then filled with fine fluid plaster, and the plane of the mould formed by its resting on the surface of the table covered to a sufficient thickness with coarse plaster, to form a strong basis or support for the cast where this support is requisite, as is particularly the case where the thin and membranous parts of the body are to be represented. After the plaster is poured into the mould, it must be suffered to stand until it has acquired the greatest degree of hardness it will receive; after which the mould must be removed: but this will be attended with some difficulty when the shape of the subject is unfavourable; and in some cases the mould must be separated by means of a small mallet and chissel. If by these instruments any parts of the model should be broken off, they may be cemented by making the two surfaces to be applied to each other quite wet; then interposing betwixt them a little liquid plaster; and lastly, the joint smoothed after being thoroughly dry. Any small holes that may be made in the mould can be filled up with liquid plaster, after the sides of them have been thoroughly wetted, and smoothed over with the edge of a knife.

In many cases it is altogether impracticable to prepare a mould of one piece for a whole subject; and therefore it must be considered how this can be done in such a manner as to divide the mould into the fewest pieces. This may be effected by making every piece cover as much of the pattern as possible, without surrounding such projecting parts, or running into such hollows as would not admit a separation of the mould. It is impossible, however, to give any particular directions in this matter which can hold good in every instance, the number of pieces of which the mould is to consist being always determined from the shape of the pattern. Thus the mould of the human calculus will require no more than three pieces, but that of an *os femoris* could scarce have fewer than ten or twelve.—Where any internal pieces are required, they are first to be made, and then the outer pieces after the former have become hard.

To make a mould upon a hard and dry substance, we must, in the first place, rub the surface of it smoothly over with the mixture of oil and lard above mentioned. Such hollows as require internal pieces are then to be filled up with fluid plaster; and while it continues in this state, a wire loop must be introduced into it, by which, when hardened, it can be pulled off. The plaster should be somewhat raised in a pyramidal form around this wire, and afterwards cut smooth with a knife while yet in its soft state; preserving two or three angular ridges from the loop to the outer edge, that it may fix the more steadily in the outer piece of the mould to be afterwards made upon it. Let the outer piece then be well greased, to prevent the second piece from adhering; the loop being enclosed with some glaziers putty, both to prevent the second piece from adhering and to preserve a hollow place for the cord. Model.

To form the second or outside piece, mix a quantity of plaster proportioned to the extent of surface it is to cover and the intended thickness of the mould: when it is just beginning to thicken, or assumes such a consistence as not to run off very easily, spread it over the internal piece or pieces as well as the pattern, taking care at the same time not to go too far lest it should not deliver safely; and as the plaster becomes more tenacious, add more upon the pattern until it has become sufficiently thick, keeping the edges square and smooth like the edge of a board. The plaster should be spread equally upon all parts, which is best done by a painter's pallet knife or apothecary's bolus knife: but for this the instrument should be somewhat less pliable than it is commonly made.

When the outside piece is hardened, the edges are to be pared smooth, and nearly made square with a small pointed knife. Little holes of a conical shape are to be made with the point of a knife about an inch distant from one another, according to the size of the piece. These are designed to receive the fluid plaster in forming the adjacent parts of the mould, and occasion points corresponding to the hollows; and are intended to preserve the edges of the different pieces steadily in their proper relative situations. The third piece is then to be formed in a manner similar to the second; greasing the edges of the former plentifully with hog's lard and oil, to prevent the pieces from adhering to each other. Thus the pattern is to be wholly enclosed, only leaving a proper orifice for pouring in the plaster to form the model; small holes being also bored in the mould opposite to the wire-loops fixed in the inside pieces, through which a cord is to be conveyed from the loop to confine such pieces during the time of casting. In some cases, however, it is not necessary that the mould should totally enclose the pattern; for instance, where a model is to be made of a pedestal, or a bust of any part of the human body. The bottom of such moulds being left open, there is accordingly ample room for pouring in the plaster.

After the mould is completely formed, it is next to be dried either naturally or by a gentle artificial heat, and then seasoned in the following manner:—Having been made thoroughly dry, which, if the mould is large, will require two or three weeks, it is to be brushed over plentifully with linseed oil boiled with sugar of lead, finely levigated litharge, or oil of vitriol. The inside and joints of the mould should be particularly well supplied with it. If the mould be large, it is needless to attend to the outside; but when the moulds are small, it will not be improper to boil them in the oil; by which means their pores are more exactly filled than could otherwise be done. After the moulds have undergone this operation, they are again set by to dry, when, being greased with olive oil and hog's lard, they are fit for use. If linseed oil be used for greasing the moulds, it will in a short time impart a disagreeable yellow colour to the casts.

The

Model. The mould being properly prepared and seasoned, nothing more is requisite to form the model than to pour the finest liquid plaster of Paris into it. After a layer of this, about half an inch in thickness, has been formed all round the mould, we may use the coarser kind to fill it up entirely, or to give to the model what thickness we please.

4 Models from living subjects. Besides the models which are taken from inanimate bodies, it has been frequently attempted to take the exact resemblance of people while living, by using their face as the original of a model, from whence to take a mould; and the operation, however disagreeable, has been submitted to by persons of the highest ranks in life. A considerable difficulty occurs in this, however, by reason of the person's being apt to shrink and distort his features when the liquid is poured upon him; neither is he altogether without danger of suffocation, unless the operator well understands his business.

To avoid the former inconvenience, it will be proper to mix the plaster with warm instead of cold water, by which means the person will be under no temptation to shrink; and to prevent any danger of a fatal accident, the following method is to be practised: Having laid the person horizontally on his back, the head must first be raised by means of a pillow to the exact position in which it is naturally carried when the body is erect; then the parts to be represented must be very thinly covered over with fine oil of almonds by means of a painter's brush; the face is then to be first covered with fine fluid plaster, beginning at the upper part of the forehead, and spreading it over the eyes, which are to be kept close, that the plaster may not come in contact with the globe; yet not closed so strongly as to cause any unnatural wrinkles. Cover then the nose and ears, plugging first up the *meatus auditorii*, with cotton, and the nostrils with a small quantity of tow rolled up, of a proper size, to exclude the plaster. During the time that the nose is thus stopped, the person is to breathe through the mouth: in this state the fluid plaster is to be brought down low enough to cover the upper lip, observing to leave the rolls of tow projecting out of the plaster. When the operation is thus far carried on, the plaster must be suffered to harden; after which the tow may be withdrawn, and the nostrils left free and open for breathing. The mouth is then to be closed in its natural position, and the plaster brought down to the extremity of the chin. Begin then to cover that part of the breast which is to be represented, and spread the plaster to the outsides of the arms and upwards, in such a manner as to meet and join that which is previously laid on the face: when the whole of the mass has acquired its due hardness, it is to be cautiously lifted, without breaking, or giving pain to the person. After the mould is constructed, it must be seasoned in the manner already directed; and when the mould is cast, it is to be separated from the mould by means of a small mallet and chissel. The eyes, which are necessarily shown closed, are to be carved, so that the eyelids may be represented in an elevated posture; the nostrils hollowed out, and the back part of the head, from which, on account of the hair, no mould can be taken, must be finished according to the skill of the artist. The edges of the model are then to be neatly smoothed off, and the bust fixed on its pedestal. Model.

The method of making models in the plaster of Paris is undoubtedly the most easy way of obtaining them. When models, however, are made of such large objects that the model itself must be of considerable size, it is vain to attempt making it in the way above described. Such models must be constructed by the hand with some soft substance, as wax, clay, putty, &c. and it being necessary to keep all the proportions with mathematical exactness, the construction of a single model of this kind must be a work of great labour and expence as well as of time. Of all those which have been undertaken by human industry, however, perhaps the most remarkable is that constructed by General Psiffer, to represent the mountainous parts of Switzerland. It is composed of 142 compartments, of different sizes and forms, respectively numbered, and so artfully put together, that they can be separated and replaced with the greatest ease. The model itself is $20\frac{1}{2}$ feet long and 12 broad, and formed on a scale which represents two English miles and a quarter by an English foot: comprehending part of the cantons of Zug, Zurich, Schweitz, Underwalden, Lucern, Berne, and a small part of the mountains of Glarus; in all, an extent of country of $18\frac{1}{2}$ leagues in length and 12 in breadth, The highest point of the model, from the level of the centre (which is the lake of Lucerne), is about ten inches; and as the most elevated mountain represented therein rises 1475 toises or 9440 feet above the lake of Lucerne, at a gross calculation, the height of an inch in the model is about 900 feet. The whole is painted of different colours, in such a manner as to represent objects as they exist in nature; and so exactly is this done, that not only the woods of oak, beech, pine, and other trees, are distinguished, but even the strata of the several rocks are marked, each being shaped upon the spot, and formed of granite, gravel, or such other substances as compose the natural mountain. So minute also is the accuracy of the plan, that it comprises not only all the mountains, lakes, rivers, towns, villages, and forests, but every cottage, bridge, torrent, road, and even every path is distinctly marked. 5 Topographical models, &c.

The principal material employed in the construction of this extraordinary model, is a mixture of charcoal, lime, clay, a little pitch, with a thin coat of wax; and is so hard that it may be trod upon without any damage. It was begun in the year 1766, at which time the general was about 50 years of age, and it employed him till the month of August 1785; during all which long space of time he was employed in the most laborious and even dangerous tasks.—He raised the plans with his own hands on the spot, took the elevation of mountains, and laid them down in their several proportions. In the prosecution of this laborious employment, he was twice arrested for a spy; and in the popular cantons was frequently forced to work by moon light, in order to avoid the jealousy of the peasants, who imagined that their liberty would be endangered should a plan of their country be taken with such minute exactness. Being obliged frequently to remain on the tops of some of the Alps, where no provisions could be procured, he

Model, Modena.

he took along with him a few milk goats, who supplied him with nourishment. When any part was finished, he sent for the people residing near the spot, and desired them to examine each mountain with accuracy, whether it corresponded, as far as the smallness of the scale would admit, with its natural appearance; and then, by frequently retouching, corrected the deficiencies. Even after the model was finished, he continued his Alpine expeditions with the same ardour as ever, and with a degree of vigour that would fatigue a much younger person. All his elevations were taken from the level of the lake Lucerne; which, according to M. Saussure, is 1408 feet above the level of the Mediterranean.

MODENA, a duchy of Italy, bounded on the south by Tuscany and the republic of Lucca, on the north by the duchy of Mantua, on the east by the Bolognese and the territories of the Church, and on the west by the duchy of Parma; extending in length from south to north about 56 English miles, and in breadth between 24 and 36, and yielding plenty of corn, wine, and fruits, with mineral waters. In some places also petroleum is skimmed off the surface of the water of deep wells made on purpose; and in others is found a kind of earth or tophus, which, when pulverized, is said to be an excellent remedy against poison, fevers, dysenteries, and hypochondriac disorders. The country of La Salsa affords several kinds of petrifactions. The principal rivers are the Crostolo, Secchia, and Panaro. The family of Esté, dukes of Modena, is very ancient. They had their name from Esté, a small city in the district of Padua. They retained the sovereignty of this duchy till it was conquered by the French in 1795. After this it formed a part of the Cisalpine republic, and latterly of the kingdom of Italy. But since the peace of Paris in 1814 it has regained its independence. The duke, though a vassal of the empire, has an unlimited power within his own dominions.

MODENA, an ancient city, in Latin *Mutina*, which gives name to a duchy of Italy, and is its capital. It stands in a rich plain 28 miles east of Parma, 44 almost south of Mantua, and 20 west of Bologna; and is a pretty large, but not a handsome city, with a population of 23,000. It is much celebrated by Roman authors for its grandeur and opulence; but was a great sufferer by the siege it underwent during the troubles of the triumvirate. Mr Keysler says, that when Decius Brutus was besieged here by Mark Antony, Hirtius the consul made use of carrier pigeons; and that, even at this day, pigeons are trained up at Modena to carry letters and bring back answers. This city hath given birth to several celebrated persons, particularly Tasso the poet, Corregio the great painter, Sigonius the civilian and historian, Da Vignola the architect, and Montecuculi the imperial general. The tutelary saint of it is named *Geminianus*. The ducal palace is a very noble edifice; but the collection of pictures and curiosities it formerly contained is no longer there. The only manufacture for which this city is noted, is that of masks, of which great numbers are exported. The women have a singular *costume*; they cover the head and body with a large silk cloak or veil, which gives them the appearance of old women or masked dominos. The churches of the Jesuits, of the Theatines, and of St Dominic, are well worth viewing. The university, now called the Lyceum, has produced several good scholars in the belles lettres, sciences, and polities. There is also a neat theatre here, and an excellent library. St Beatrix, who was of the family of Esté, is said to knock always at the gate of the palace three days before any of the family dies. Before most of the houses are covered walks or portieoes, as at Bologna. The city is fortified, and on its south side stands the citadel. E. Long. 11. 0. N. Lat. 44. 34.

Modena || Modesty.

MODERATION, in *Ethics*, is a virtue consisting in the proper government of our appetites, passions, and pursuits, with respect to honours, riches, and pleasures; and in this sense it is synonymous with *temperance*: it is also often used to denote *candour*.

MODERATOR, in the schools, the person who presides at a dispute, or in a public assembly: thus the president of the annual assembly of the church of Scotland is styled *moderator*.

MODERN, something new, or of our time; in opposition to what is antique or *ancient*.

Modern Authors, according to Naude, are all those who have wrote since Boethius. The modern philosophy commences with Galileo; the modern astronomy with Copernicus.

MODESTY, in *Ethics*, is sometimes used to denote humility; and sometimes to express chastity, or purity of sentiments and manners.—Modesty, in this last sense, and as particularly applied to women, is defined by the authors of the *Encyclopédie Methodique*, as a natural, chary, and honest shame; a secret fear; a feeling on account of what may be accompanied with disgrace. Women who possess only the remains of a suspicious modesty, make but feeble efforts to resist: those who have obliterated every trace of modesty from their countenance, soon extinguish it completely in their soul, and throw aside for ever the veil of decency. She, on the contrary, who truly possesses modesty, passes over in silence attempts against her honour, and forbears speaking of those from whom she has received an outrage, when in doing so she must reveal actions and expressions that might give alarm to virtue.

The idea of modesty is not a chimera, a popular prejudice, or an illusion arising from laws and education. Nature, which speaks the same language to all men, has, with the unanimous consent of nations, annexed contempt to female incontinence. To resist and to attack are laws of her appointment: and while she bestows desires on both parties, they are in the one accompanied with boldness, in the other with shame. To individuals she has allotted long spaces of time for the purposes of self-preservation, and but moments for the propagation of their species. What arms more gentle than *Modesty* could she have put into the hands of that sex which she designed to make resistance.

If it were the custom for both sexes to make and receive advances indiscriminately, vain importunity would not be prevented: the fire of passion would never be stirred up, but languish in tedious liberty; the most amiable of all feelings would scarcely warm the human breast; its object would with difficulty be attained. That obstacle which seems to remove this object to a distance, in fact brings it nearer. The veil of shame only makes the desires more attractive. Modesty kindles that flame which it endeavours to suppress

Modesty || Modulation.

press: its fears, its evasions, its caution, its timid avowals, its pleasing and affecting finesses, speak more plainly what it wishes to conceal, than passion can do without it: it is MODESTY, in short, which enhances the value of a favour, and mitigates the pain of a refusal.

Since modesty is the secret fear of ignominy; and since all nations, ancient or modern, have confessed the obligation of its laws; it must be absurd to violate them in the punishment of crimes, which should always have for its object the re-establishment of order. Was it the intention of those oriental nations, who exposed women to elephants, trained for an abominable species of punishment, to violate one law by the observance of another? By an ancient practice among the Romans a girl could not be put to death before she was marriageable. Tiberius found means to evade this law, by ordering them to be violated by the executioner previous to the infliction of punishment; the refinement of a cruel tyrant, who sacrificed the morals to the customs of his people! When the legislature of Japan caused women to be exposed naked in the market places, and obliged them to walk on all fours like brutes, modesty was shocked: but when it wanted to force a mother—when it wanted to compel a son—nature received an outrage.

Such is the influence of climate in other countries, that the physical part of love possesses an almost irresistible force. The resistance is feeble; the attack is accompanied with a certainty of success. This is the case at Patana, at Bantam, and in the small kingdoms on the coast of Guinea. When the women in these countries (says Mr Smith) meet with a man, they lay hold of him and threaten to inform their husbands if he despises their favours. But here the sexes seem to have abolished the laws peculiar to each. It is fortunate to live in a temperate climate like ours, where that sex which possesses the most powerful charms exerts them to embellish society; and where modest women, while they reserve themselves for the pleasures of one, contribute to the amusement of all.

MODIFICATION, in *Philosophy*, that which modifies a thing, or gives it this or that manner of being. Quantity and quality are accidents which modify all bodies.

Decree of MODIFICATION, in *Scots Law*, a decree ascertaining the extent of a minister's stipend, without proportioning it among the persons liable in payment.

MODILLIONS, in *Architecture*, ornaments in the corniche of the Ionic, Corinthian, and Composite columns.

MODIUS, a Roman dry measure for all sorts of grain, containing 32 heminæ, or 16 sextarii, or one-third of the amphora; amounting to an English peck. See MEASURE.

MODULATION, the art of forming any thing to certain proportion.

MODULATION, in reading or speaking. See READING.

MODULATION, in *Music*, derived from the Latin *modulari*. This word, in our language, is susceptible of several different significations. It frequently means no more than an air, or a number of musical sounds properly connected and arranged. Thus it answers to what Mr Malcolm understands by the word *tune*, when he does not expressly treat concerning the tuning of instruments. Thus likewise it expresses the French word *chant;* for which reason, in the article MUSIC, we have frequently expressed the one word by the other. But the precise and technical acceptation to which it ought to be confined, is the art of composing melody or harmony agreeably to the laws prescribed by any particular key, that of changing the key, or of regularly and legitimately passing from one key to another. See MUSIC.

Modulation || Mogodore

MODULE, in *Architecture*, a certain measure, or bigness, taken at pleasure, for regulating the proportions of columns, and the symmetry or disposition of the whole building. Architects generally choose the semidiameter of the bottom of the column for their module, and this they subdivide into parts or minutes.

MOEONIA, or MÆONIA. See MÆONIA and LYDIA.

MOESIA, or MYSIA, in *Ancient Geography*, a country of Europe, extending from the confluence of the Savus and the Danube to the shores of the Euxine. It was divided into Upper and Lower Mœsia. Lower Mœsia was on the borders of the Euxine, and comprehended that tract of country which received the name of *Pontus* from its vicinity to the sea. Upper Mœsia lay beyond the other in the inland country.

MOFFAT, a village of Scotland, in Annandale, in the county of Dumfries, 50 miles south-west of Edinburgh; famous for its sulphureous well, which has been in just estimation for near 150 years as a remedy in all cutaneous and scrofulous complaints; and for its chalybeate spring, called Hartfell spaw, which was discovered above 50 years ago, and is of a very bracing quality.—The place is chiefly supported by the company who resort thither for the benefit of its waters and air; but it has also a manufacture of coarse woollen stuffs. It is a well-built clean village; and contains many good and even elegant lodgings, a tolerable assembly room, a bowling green and walks, and a good inn. The population of the parish in 1811 amounted to 1834.

MOFFETTA. See AMPSANCTI.

MOGODORE, or MAGADORE, a large, uniform, and well built town in the kingdom of Morocco, situated about 350 miles from Tangier on the Atlantic ocean, and surrounded on the land side by deep and heavy sands. The European factory here consists of about a dozen mercantile houses of different nations, whose owners, from the protection granted them by the emperor, live in full security from the Moors, whom indeed they keep at a rigid distance. They export, to America, mules; to Europe, Morocco leather, hides, gum arabic, gum sandaric, ostrich feathers, copper, wax, wool, elephants teeth, fine mats, beautiful carpeting, dates, figs, raisins, olives, almonds, oil, &c. In return, they import timber, artillery of all kinds, gunpowder, woollen cloths, linens, lead, iron in bars, all kinds of hardware and trinkets, such as looking glasses, snuff boxes, watches, small knives, &c. tea, sugar, spices, and most of the useful articles which are not otherwise to be procured in this empire. The town is regularly fortified on the sea side; and on the land, batteries are so placed as to prevent any incursion from the southern Arabs, who

are

Mogodore, Moguls.

are of a turbulent disposition, and who, from the great wealth which is known to be always in Mogodore, would gladly avail themselves of any opportunity that offered to pillage the town. The entrance, both by sea and land, consists of elegant stone arch-ways, with double gates. The market place is handsomely built, with piazzas of the same materials; and at the water port there is a customhouse and powder magazine, both of which are neat stone buildings. Besides these public edifices, the emperor has a small but handsome palace for his occasional residence. The streets of the town, though very narrow, are all in straight lines; and the houses, contrary to what we meet with in the other towns of the empire, are lofty and regular. The bay, which is a little better than a road, and is very much exposed when the wind is at north-west, is formed by a curve in the land, and a small island about a quarter of a mile from the shore. —Its entrance is defended by a fort well furnished with guns.

MOGULS, a celebrated nation of Asia, whose conquests formerly were the most rapid and extensive of any people recorded in history. They themselves deduce their origin from Japhet, or, as they call him, *Japhis*, the son of Noah. His son Turk, they say, was the first king, or khan, of those nations who are now known by the separate names of *Turks*, *Tartars*, and *Moguls;* and the Tartars especially assert, that their proper designation is *Turks*. To this prince is attributed many of those inventions which barbarous nations commonly ascribe to their first sovereigns. He was succeeded by Taunak; in whose reign the whole posterity of Turk were divided into four large tribes, denominated the *orda's* of Erlat, Gialair, Kaugin, Berlas or Perlas; of which last came the famous Timur Beg, or Tamerlane.—From this time to that of Alanza Khan, we meet with nothing remarkable. In his reign the Turks being immersed in all kinds of luxury, universally apostatized into idolatry. Having two sons, Tartar and Mogul, he divided his dominions among them, and thus gave rise to the two empires of the Tartars and Moguls.

1 Moguls descended from Japhet.

The two nations had not long existed before they began to make war upon each other; and after long contention, the event at last was, that Il Khan, emperor of the Moguls, was totally overthrown by Siuntz Khan, emperor of the Tartars; and so great was the defeat, that the Mogul nation seems to have been almost exterminated. Only two of Il Khan's family survived this disaster. These were Kajan his youngest son, and Nagos his nephew, who were both of an age, and had both been married the same year. These two princes, with their wives, had been taken prisoners by Siuntz Khan, but found means to make their escape to their own country. Here they seized upon all the cattle which had not been carried off by the Tartars; which was easily done, as having none to dispute the property with them; then stripping some of the slain, they took their clothes, and retired into the mountains. They passed several mountains without much difficulty; but at last advanced to the foot of one exceedingly high, which had no way over it but a very small path made by certain animals, called in the Tartar language *arhara*. This path they found themselves obliged to make use of, though it was so strait, that only one could pass at a time, and he was in the most imminent danger of breaking his neck at the least false step. Having ascended the mountain on one side by this path, they descended by the same on the other side; and were agreeably surprised to find themselves in a most delightful tract, interspersed with rivulets and charming meadows, abounding with a vast variety of delicious fruits, and enclosed on all sides by inaccessible mountains, in such a manner as to shelter them from all future pursuits of the Tartars. Here they lived some time, and gave this beautiful country the name of *Irgana-kon*, in allusion to its situation; *Irgana* signifying, in the old language of the Moguls, a "valley," and *Kon* a "steep height."

2 Almost exterminated

Moguls.

3 They arrive in a delightful valley.

In process of time these two families very much increased. Kajan, whose posterity was the most numerous, called his descendants *Kajath;* but the people springing from Nagos were divided into two tribes; one of which received the appellation of *Nagosler*, and the other that of *Durlagan*.

These two Mogul princes and their descendants lived in this place for more than 400 years; but the latter then finding it too narrow for them, meditated a return to the country from which their forefathers had been driven. For some time, however, they found this impracticable, as the path that conducted their ancestors had been long since destroyed. At last they discovered, that one part of the high mountain above mentioned was not very thick in a certain place; and also, that it consisted entirely of iron ore. To this, having before set fire to a layer of wood, and another of charcoal, laid along the foot of the mountain, they applied 70 large bellows, and at last melted the mountain in such a manner, that an opening was made large enough for a loaded camel to pass; and through this passage they all marched out with great joy.

4 From whence they at last issue and defeat the Tartars.

The Moguls having thus issued as it were from a new world, overthrew the Tartars in their turn; and continued to be a very considerable nation till the time of their great hero Temujin, afterwards called *Jenghiz Khan*, whom they extol in the most extravagant manner. It is difficult, however, to say, at the time Temujin made his appearance, how far the dominions of the Moguls extended, or in what estimation they were held by their neighbours. It seems to be pretty certain that great part of the vast region, now known by the name of *Tartary*, was then in a state of considerable civilization, and likewise extremely populous, as we find mention made of many cities which the Moguls destroyed; and the incredible multitudes whom they slaughtered, abundantly show the populousness of the country. On the east, the country of the Moguls and Tartars had the great desert which divides Tartary from China; on the west, it had the empire of Karazm, founded by Mahmud Gazni; and on the south were the countries now known by the name of *Indostan*, *Siam*, *Pegu*, *Tonquin*, and *Cochin China*. Thus it comprehended the eastern part of modern Tartary, and all Siberia. This whole region was divided among a great number of *Aymacks*, or *tribes;* who had each one or more khans, according as it was more or less numerous, or divided into branches. Among these that of the *Kara-its* was the most powerful: their

5 State of Asia at the time of Jenghiz Khan.

Moguls. prince assumed the title of *Grand Khan*, and among the rest the Moguls were tributary to him; but, according to the Chinese historians, both the one and the other were tributary to the emperor of Kitay or Katay. China was divided into two parts: the nine southern provinces were in the hands of the Chinese emperors of the Song dynasty, who kept their court at Hang-chew, the capital of the province of Chekyang; the five northern provinces, excepting part of Shensi, were possessed by the Kin, a people of Eastern Tartary, from whom are descended the Manchew Tartars, at present masters of China. This vast dominion was named *Kitay* or *Katay*, and was divided into two parts: that which belonged to China, was properly called *Kitay;* and the part which belonged to Tartary was called *Karakitay*, in which some even include the territories of the Moguls, Karaits, and other tribes which are the subject of the present history. The western part of the empire of Kitay was possessed by a Turkish prince, who had lately founded a new kingdom there called *Hya;* whose capital city was Hyachew, now Ninghya in Shensi, from whence the kingdom took its name. To the west of Hya lay Tangut; a country of great extent, and formerly very powerful; but at that time reduced to a low state, and divided among many princes; some of whom were subject to the emperor of Hya, and others to the emperor of China. All Tartary to the westward as far as the Caspian sea, with the greater part of Little Buckharia, which then passed under the general name of *Turkestan*, was subject to Ghurkhan, Khurkhan, or Kaver Khan; to whom even the Gazni monarchs are said to have been tributary. This Ghurkhan had been prince of the Western Kitan or Lyau; who, driven out of Kitay by the king, settled in Little Buckharia, and the country to the north, where they founded a powerful state about the year 1124.

6 Descent and birth of Temujin. Thus the Moguls, properly so called, had but a very small extent of empire which could be called their own, if indeed they had any, when Temujin made his appearance. This hero is said by the Tartars to have been of divine origin, since his family could be traced no farther back than ten generations, the mother of whom was got with child by a spirit. The names and transactions of his predecessors are equally uncertain and unimportant: he himself, however, was born in the year 1163, and is said to have come into the world with congealed blood in his hands; from whence it was prognosticated that he would be a great warrior, and obtain the victory over all his enemies.

This prediction, if any such there was, Temujin most literally fulfilled. At the time of his father's decease, his subjects amounted to between 30,000 and 40,000 families; but of these two-thirds quickly deserted, and Temujin was left almost without subjects. When only 13 years of age, he fought a bloody battle against these revolters; but either was defeated, or gained an indecisive victory; so that he remained in obscurity for 27 years longer. His good fortune at last he owed to the friendship of Vang Khan, who ruled over a great number of Tartar tribes to the north of Kitay, and has been heard of under the name of *Prester John* among the Europeans. This prince took Temujin under his protection; and a rebellion being afterwards raised against himself, Temujin was made his general, and the khan was kept in possession of his throne: soon after which Temujin subdued the tribes which had revolted from himself, treating them at the same time with the utmost barbarity. Moguls.

7 Subdues his revolted subjects by means of Vang Khan.

8 Who becomes jealous, and contrives his destruction. This happened in the year 1201; but Vang Khan, instead of continuing the friend of Temujin, now became jealous, and resolved to destroy him by treachery. With this view he proposed a marriage between Temujin's son Juji and his own daughter, and another between Temujin's daughter and his own son. Temujin was invited to the camp of Vang Khan, in order to celebrate this double marriage; but receiving intelligence of some evil intention against him, he excused himself to Vang Khan's messengers, and desired that the ceremony might be put off to some other time.

A few days after the departure of these messengers, Badu and Kishlik, two brothers, who kept the horses of one of Vang Khan's chief domesties, came and informed Temujin, that the grand Khan finding he had missed his aim, was resolved to set out instantly, and surprise him next morning, before he could suspect any danger. Temujin, alarmed at this intelligence, quitted his camp, in the night time, and retired with all his people to some distance. He was scarce gone when Vang Khan's troops arrived, and discharged an incredible number of arrows among the empty tents; but finding nobody there, they pursued Temujin in such haste that they fell into great disorder. In this condition they were suddenly attacked and routed by Temujin; after which an open war with Vang Khan took place.

9 Temujin overcomes all his enemies. By this quarrel almost all the princes of Tartary were put in motion, some siding with Temujin, and others with Vang Khan. But at last fortune declared in favour of the former: Vang Khan was overthrown in a battle, where he lost 40,000 men, and obliged to fly for refuge to a prince named *Tayyan Khan*, who was Temujin's father-in-law, and his own enemy, and by whom he was ungenerously put to death. Temujin immediately began to seize on his dominions, great part of which voluntarily submitted: but a confederacy was formed against him by a number of Vang Khan's tributaries, at the head of whom was Jamuka, a prince who had already distinguished himself by his enmity to Temujin; and even Tayyan Khan himself was drawn into the plot, through jealousy of his son-in-law's good fortune. But Temujin was well prepared; and in the year 1204 attacked Tayyan Khan, entirely routed his army, killed himself, and took Jamuka prisoner, whose head he caused instantly to be struck off; after which he marched against the other tribes who had conspired against him. Them he quickly reduced; took a city called *Kashin*, where he put all to the sword who had borne arms against him; and reduced all the Mogul tribes in 1205.

Temujin now, having none to oppose him, called a general diet, which he appointed to be held on the first day of the spring 1206; that is, on the day in which the sun entered Aries. To this diet were summoned all the great lords both Moguls and Tartars; and in the mean time, to establish good order in the army, he divided his soldiers into bodies of 10,000, 1000, 100, and 10 men, with their respective officers, all subordinate to the generals, or those who commanded the bodies of 10,000; and these were to act under his own

Moguls. own sons. On the day of holding the diet, the princes of the blood and great lords appeared dressed in white. Temujin dressed in the same manner, with his crown on his head, sat down on his throne, and was complimented by the whole assembly, who wished him the continuance of his health and prosperity. After this they confirmed the Mogul empire to him and his successors, adding all those kingdoms which he had subdued, the descendants of whose vanquished khans were deprived of all right or title to them; and after this he was proclaimed emperor with much ceremony. During this inauguration, a pretended prophet declared that he came from God to tell the assembly, that from thenceforth Temujin should assume the name of *Jenghiz Khan*, or *the most Great Khan of khans;* prophesying also, that all his posterity should be khans from generation to generation. This propheey, which was no doubt owing to Temujin himself, had a surprising effect on his subjects, who from that time concluded that all the world belonged of right to them, and even thought it a crime against heaven for any body to pretend to resist them.

10 Assumes the title of Jenghiz Khan.

Jenghiz Khan having now reduced under his subjection all the wandering tribes of Moguls and Tartars, began to think of reducing those countries to the south and south-west of his own, where the inhabitants were much more civilized than his own subjects: and the countries being full of fortified cities, he must of course expect to meet with more resistance. He began with the emperor of Hya, whose dominions he invaded in 1209, who at last submitted to become his tributary. But in the mean time Jenghiz Khan himself was supposed to be tributary to the emperor of Kitay: who, in 1210, sent him an officer demanding the customary tribute. This was refused with the utmost indignation, and a war commenced, which ended not but with the dissolution of the empire of Kitay, as mentioned under the article CHINA.

11 Invades Hya, China, &c.

In the year 1216, Jenghiz Khan resolved to carry his arms westward, and therefore left his general Muchuli to pursue his conquests in Kitay. In his journey westward he overthrew an army of 300,000 Tartars who had revolted against him; and, in 1218, sent ambassadors desiring an alliance with Mohammed Karazm Shah, emperor of Gazna. His ambassador was haughtily treated: however, the alliance was concluded; but soon after broken, through the treachery, as it is said, of the Karazmian monarch's subjects. This brought on a war attended with the most dreadful devastations, and which ended with the entire destruction of the empire of Karazm or Gazna, as related under the article GAZNA.

After the reduction of Karazm, part of the Moguls broke into Iran or Persia, where also they made large conquests, while others of their armies invaded Georgia and the countries to the west; all this time committing such enormities, that the Chinese historians say both men and spirits burst with indignation. In 1225, Jenghiz Khan returned to Hya, where he made war on the emperor for having sheltered some of his enemies. The event was, that the emperor was slain, and his kingdom conquered, or rather destroyed; which, however, was the last exploit of this most cruel conqueror, who died in 1227, as he marched to complete the destruction of the Chinese.

The Mogul empire, at the death of Jenghiz Khan, extended over a prodigious tract of country; being more than 1800 leagues in length from east to west, and upwards of 1000 in breadth from north to south. Its princes, however, were still insatiable, and pushed on their conquests on all sides. Oktay was acknowledged emperor after Jenghiz Khan; and had under his immediate government Mogulestan (the country of the Moguls properly so called), Kitay, and the countries eastward to the Tartarian sea. Jagaty his brother governed under him a great part of the western conquests. The country of the Kipjacks, and others to the east and north-east, north and north-west, were governed by Batu or Patu the son of Juji, who had been killed in the wars; while Tuli or Toley, another son of Jenghiz Khan, had Khorassan, Persia, and what part of India was conquered. On the east side the Mogul arms were still attended with success; not only the empire of Kitay, but the southern part of CHINA, was conquered, as already related under that article, N° 24—42. On the west side matters continued much in the same way till the year 1254, when Magu, or Menkho, the fourth khan of the Moguls, (the same who was afterwards killed at the siege in China*), raised a great army, which he gave to his brother Hulaku or Hulagu, to extend his dominions westward. In 1255, he entered Iran, where he suppressed the Ismaelians or Assassins, of whom an account is given under the article ASSASSINS, and two years afterwards he advanced to Bagdad, which he took, and cruelly put the caliph to death, treating the city with no more lenity than the Moguls usually treated those which fell into their hands. Every thing was put to fire and sword; and in the city and its neighbourhood the number of slain, it is said, amounted to 1,600,000. The next year he invaded Syria; the city of Damascus was delivered up, and, as it made no resistance, the inhabitants were spared; but Aleppo being taken by storm, a greater slaughter ensued there than had taken place at Bagdad, not even the children in their cradles being spared. Some cities of this country revolted the next year, or the year after; but falling again into the hands of the Moguls, they were plundered, and the inhabitants butchered without mercy, or carried into slavery.

Moguls.

12 Vast extent of his empire.

* See *China*, N° 38.

13 Bagdad reduced.

Hulaku died in 1264, and at his death we may fix the greatest extent of the Mogul empire. It now comprehended the whole of the continent of Asia, excepting part of Indostan, Siam, Pegu, Cochin China, and a few of the countries of Lesser Asia, which had not been attacked by them; and during all these vast conquests no Mogul army had ever been conquered, except one by Jaloloddin, as mentioned under the article GAZNA.—From this period, however, the empire began to decline. The ambition of the khans having prompted them to invade the kingdoms of Japan and Cochin China, they were miserably disappointed in their attempts, and lost a great number of men. The same bad success attended them in Indostan; and in a short time this mighty empire broke into several smaller ones. The governors of Persia being of the family of Jenghiz Khan, owned no allegiance to any superior; those of Tartary did the same. The Chinese threw off the yoke; and thus the continent of Asia wore much the same face that it had done before Jenghiz Khan began his conquests.

14 It begins to decline.

The

Moguls.

The successors of Hulaku reigned in Persia till the year 1335; but that year Abusaid Khan, the eighth from Hulaku, dying, the affairs of that country fell into confusion for want of a prince of the race of Jenghiz Khan to succeed to the throne. The empire, therefore, was divided among a great number of petty princes who fought against each other almost without intermission, till in the year 1369 Timur Bek, or Tamerlane, one of these princes, having conquered a number of others, was crowned at Balkh, with the pompous title of *Saheb Karan;* that is, "the emperor of the age, and the conqueror of the world." As he had just before taken that city, and destroyed one of his most formidable rivals who had shut himself up in it, the new emperor began his reign with beheading some of the inhabitants, imprisoning others, burning their houses, and selling the women and children for slaves. In 1370 he crossed the Sihun, made war on the Getes, and attacked Karazm. Next year he granted a peace to his enemies; but two years after, he again invaded the country of the Getes, and by the year 1379 had fully conquered that country as well as Korazan; and from that time he continued to extend his conquests in much the same manner as Jenghiz Khan had done, though with less cruelty.—In 1387 he had reduced Armenia, Georgia, and all Persia; the conquest of which last was completed by the reduction of Ispahan, 70,000 of the inhabitants of which were slaughtered on account of a sedition raised by some rash or evil disposed persons.

15 Tamerlane crowned emperor of Balkh.

16 Becomes a great conqueror.

After the reduction of Persia, Timur turned his arms northward and westward, subduing all the countries to the Euphrates. He took the city of Bagdad; subdued Syria; and having ravaged great part of Russia, returned to Persia in 1396, where he splendidly feasted his whole army. In 1398 he invaded Indostan, crossed the Indus on the 17th of September, reduced several fortresses, and made a vast number of captives. However, as he was afraid that, in case of any emergency, these prisoners might take part with the enemy, he gave orders to his soldiers to put all their Indian slaves to death; and in consequence of this inhuman order, more than 100,000 of these poor wretches were slaughtered in less than an hour.

17 Invades and conquers Indostan.

In the beginning of the year 1399 Timur was met by the Indian army; whom, after a desperate battle, he defeated with great slaughter, and soon after took the city of Delhi the capital of the country. Here he seated himself on the throne of the Indian emperors, and here the sharifs, kadis, the principal inhabitants of the city, came to make their submission, and begged for mercy. The tame elephants and rhinoceroses likewise were brought to kneel before him as they had been accustomed to do to the Indian emperors, and made a great cry as if they implored his clemency. These war elephants, 120 in number, were, at his return, sent to Samarcand, and to the province where his sons resided. After this, at the request of the lords of the court, Timur made a great feast; at which he distributed presents to the princes and principal officers.

18 The city of Delhi destroyed, and the inhabitants slaughtered.

Delhi at this time consisted of three cities, called *Seyri*, *Old Delhi*, and *Jehan Penah*. Seyri was surrounded with a wall in form of a circle. Old Delhi was the same, but much larger, lying south-west of the other. These two parts were joined on each side by a wall: and the third, lying between them, was called *Jehan Penah*, which was larger than Old Delhi. Penah had ten gates; Seyri had seven, three of which looked towards Jehan Penah; this last had 13 gates, six to the north-west, and seven to the south-east. Every thing seemed to be in a quiet posture; when, on the 12th of January 1399, the soldiers of Timur being assembled at one of the gates of Delhi, insulted the inhabitants of the suburbs. The great emirs were ordered to put a stop to these disorders; but their endeavours were not effectual. The sultanas having a curiosity to see the rarities of Delhi, and particularly a famous palace adorned with 1000 pillars, built by an ancient king of India, went in with all the court; and the gate being on that occasion left open for every body, above 15,000 soldiers got in unperceived. But there was a far greater number of troops in a large place between Delhi, Seyri, and Jehan Penah, who committed great disorders in the two last cities. This made the inhabitants in despair fall on them; and many, setting fire to their houses, burnt their wives and children. The soldiers seeing this confusion, did nothing but pillage the houses; while the disorder was increased by the admission of more troops, who seized the inhabitants of the neighbouring places who had fled thither for shelter. The emirs, to put a stop to this mischief, caused the gates to be shut: but they were quickly opened by the soldiers within, who rose in arms against their officers; so that by the morning of the 13th the whole army was entered, and this great city was totally destroyed. Some soldiers carried out 150 slaves, men, women, and children; nay, some of their boys had 20 slaves a piece to their share. The other spoils, in jewels, plate, and manufactures, were immense; for the Indian women and girls were adorned with precious stones, and had bracelets and rings on their hands, feet, and even toes, so that the soldiers were loaded with them. On the 15th, in Old Delhi, the Indians retired into the great mosque to defend themselves; but being attacked by the Tartars they were all slaughtered, and towers erected with their heads. A dreadful carnage now ensued throughout the whole city, and several days were employed before the inhabitants could be made to quit it entirely; and as they went, the emirs took a number of them for their service. The artisans were also distributed among the princes and commanders; all but the masons, who were reserved for the emperor, in order to build him a spacious stone mosque at Samarcand.

Moguls.

After this terrible devastation, Timur marched into the different provinces of Indostan, everywhere defeating the Indians who opposed him, and slaughtering the Ghebrs or worshippers of fire. On the 25th of March he set out on his return, and on the 9th of May arrived at Samarcand. In a few months after his arrival, he was obliged to undertake an expedition into Persia, where affairs were in the utmost disorder on account of the misconduct of his son, whom he had appointed sovereign of that empire. Here Timur soon settled matters; after which he again set out on an expedition westward, reduced many places in Georgia which had not submitted before, and invaded and conquered Syria. At the same time he quarrelled with Bajazet the Turkish sultan, then busied in an enterprise against Constantinople, in which he would probably have succeeded had not Timur interposed. The cause of this quarrel

19 Timur quarrels with Bajazet the Turkish sultan.

Moguls. quarrel at first was, that Bajazet had demanded tribute from a prince who was under Timur's protection, and is said to have returned an insulting answer to the Tartar ambassadors who were sent to him on that account. Timur, however, who was an enthusiast in the cause of Mahometanism, and considered Bajazet as engaged in the cause of heaven when besieging a Christian city, was very unwilling to disturb him in so pious a work; and therefore undertook several expeditions against the princes of Syria and Georgia, in order to give the Turkish monarch time to cool and return to reason. Among other places, he again invested the city of Bagdad, which had cast off its allegiance to him; and having taken it by storm, made such a dreadful massacre of the inhabitants, that 120 towers were erected with the heads of the slain. In the mean time Bajazet continued to give fresh provocation, by protecting one Kara Yusef a robber, who had even insulted the caravan of Mecca; so that Timur at length resolved to make war upon him. The sultan, however, foreseeing the danger of bringing such a formidable enemy against himself, thought proper to ask pardon, by a letter, for what was past, and promise obedience to Timur's will for the future. This embassy was graciously received; and Timur returned for answer, that he would forbear hostilities, provided Bajazet would either put Kara Yusef to death, send him to the Tartar camp, or expel him out of his dominions. Along with the Turkish ambassadors he sent one of his own; telling Bajazet that he would march into the confines of Anatolia, and there wait his final answer.

Though Bajazet had seemed at first willing to come to an agreement with Timur, and to dread his superior power; yet he now behaved in such an unsatisfactory manner, that the Tartar monarch desired him to prepare for war; upon which he raised the siege of Constantinople, and having met Timur with an army greatly inferior to the Tartars, was utterly defeated and taken prisoner. According to some accounts, he was treated with great humanity and honour; while others inform us, that he was shut up in an iron cage, against which he dashed out his brains the following year. At any rate, it is certain that he was not restored to liberty, but died in confinement.

20 Bajazet defeated and taken prisoner.

This victory was followed by the submission of many places of the Lesser Asia to Timur; the Greek emperor owned himself his tributary, as did also the sultan of Egypt. After this Timur once more returned to Georgia, which he cruelly ravaged; after which he marched to Samarcand, where he arrived in the year 1405. Here, being now an old man, this mighty conqueror began to look forward to that state which at one time or other is the dread of all living creatures; and Timur, in order to quiet the remorses of his own conscience, came to the following curious resolution, which he communicated to his intimate friends; namely, that "as the vast conquests he had made were not obtained without *some violence*, which had occasioned the destruction of a great number of God's creatures, he was resolved, by way of atonement for his past crimes, to perform some good action; namely, to make war on the infidels, and exterminate the idolaters of China." This atonement, however, he did not live to accomplish; for he died the same year of a burning fever, in the 71st year of his age and 36th of his reign.

21 Death of Tamerlane, and dissolution of his empire.

On the death of Timur, his empire fell immediately into great disorder, and the civil wars continued for five or six years; but at last peace was restored, by the settlement of Shah Rukh, Timur's son, on the throne. He did not, however, enjoy the empire in its full extent, or indeed much above one half of it; having only Karazm, Khorassan, Kandahar, Persia, and part of Hindostan. Neither was he able, though a brave and warlike prince, to extend his dominions, though he transmitted them to his son Ulug Beg. He proved a wise and learned monarch; and is famous for the astronomical tables which he caused to be composed, and which are well known at this day. He was killed in 1448 by his son Abdollatif, who six months after was put to death by his own soldiers. After the death of Abdollatif, Abdollah, a grandson of Shah Rukh, seized the throne; but, after reigning one year, was expelled by Abusaid Mirza, the grandson of Miran Shah the son of Timur. His reign was one continued scene of wars and tumults; till at last he was defeated and taken prisoner by one Hassan Beg, who put him to death in 1468. From this time we may look upon the empire of Timur as entirely dissolved, though his descendants still reigned in Persia and Indostan, the latter of which is still known by the name of the *Mogul's empire*. Moguls || Mohilof.

22 History of Hindostan.

On the death of the above-mentioned monarch, his son Babr or Babor succeeded him, but was soon driven out by the Usheck Tartars; after which he resided some time in Gazna, whence he made incursions into Hindostan, and at length became master of the whole empire, excepting the kingdoms of Dekan, Guzerat, and Bengal.—For the transactions subsequent to this period, see HINDOSTAN and INDIA.

MOHAIR, in commerce, the hair of a kind of goat frequent about Angora in Turkey; the inhabitants of which city are all employed in the manufacture of camblets made of this hair.

Some give the name *mohair* to the camblets or stuffs made of this hair; of these there are two kinds; the one smooth and plain, the other watered like tabbies: the difference between the two only consists in this, that the latter is callendered, the other not. There are also mohairs both plain and watered, whose woof is of wool, cotton, or thread.

MOHAIR Shell, in *Conchology*, a name given to a species of voluta, which seems of a closely and finely reticulated texture, and resembles on the surface a piece of mohair or a very close silkworm's web.

MOHAWK, a river of North America, which rises near lake Oneida, and runs a south-east course of about 130 miles to its junction with the Hudson, 8 miles above Albany, in the state of New York.

MOHAWKS. See MUCK.

MOHILA, or MOELIA, one of the Comora islands in the Indian sea, between the north end of Madagascar and the continent of Africa. The inland parts are mountainous and woody; but the lands adjoining to the sea are watered by several fine streams. The island abounds with provisions of all kinds; and the East India ships of different nations sometimes touch here for refreshment.

MOHILOF, a large and strong city of Russian Poland, in the province of Lithuania. It is well built, populous, and has a considerable trade. Near this

place.

Mohilof || Moivre.

place the Swedes obtained a great victory over the Russians in 1707. Lat. 53. 50. Long. 30. 14.

MOIDORE, a Portuguese gold coin, value 1l. 7s. sterling.

MOIETY (*Medietas*), the half of any thing.

MOIRA, a town of Ireland, in the county of Down and province of Ulster, 69 miles from Dublin; noted for its linen manufacture. It gives title of earl to the family of Rawdon.

MOISTURE. See HUMIDITY.

The moisture of the air has considerable effects on the human body. For the quantity and quality of the food, and the proportion of the meat to the drink, being given, the weight of a human body is less, and consequently its discharges greater in dry weather than in wet weather; which may be thus accounted for: the moisture of the air moistens the fibres of the skin and lessens perspiration by lessening their vibratory motion. When perspiration is thus lessened by the moisture of the air, urine indeed is by degrees increased, but not equally. Hence, according to Dr Bryan Robinson, we learn, that to keep a body of the same weight in wet weather as in dry, either the quantity of food must be lessened, or the proportion of the meat to the drink increased; and both these may be done by lessening the drink without making any change in the meat.

The instrument used for determining the degree of moisture in the air, is called an *hygrometer*. See HYGROMETER.

MOIVRE, ABRAHAM, a learned mathematician, was born at Vitri in Champagne, in France, 1667, where his father was a surgeon. At the revocation of the edict of Nantes, he came to England. Before he left France, he had begun the study of mathematics; and having perfected himself in that science in London, he was obliged, by necessity, to teach it. Newton's *Principia*, which accidentally fell into his hands, showed him how little progress he had made in a science of which he thought himself master. From this work he acquired a knowledge of the geometry of infinites with as great facility as he had learned the elementary geometry; and in a short time he was fit to be ranked with the most celebrated mathematicians. His success in these studies procured him a seat in the Royal Society of London and in the Academy of Sciences at Paris. His merit was so well understood in the former, that he was thought capable of deciding in the famous dispute between Leibnitz and Newton concerning the differential calculus.—He published a Treatise on Chances in 1738, and another on Annuities in 1752; both extremely accurate. The Philosophical Transactions contain many interesting memoirs of his composition.—Some of them treat of the method of fluxions; others are on the lunula of Hippocrates; others on physical astronomy, in which he resolved many important problems; and others, in short, on the analysis of the games of chance, in which he followed a different course from that of Montmort. Towards the close of his life he lost his sight and hearing; and the demand for sleep became so great that he required 20 hours of it in a day. He died at London, 1754, aged 87. His knowledge was not confined to mathematics; but he retained to the last a taste for polite literature. He was intimately acquainted with the best authors of antiquity; and he was frequently consulted about difficult passages in their works. Rabelais and Moliere were his favourite French authors: he had them by heart; and he one day observed to one of his acquaintance, "that he would rather have been Moliere than Newton." He recited whole scenes of the *Misanthrope*, with that delicacy and force with which he remembered to have heard them recited at Paris 70 years before, by Moliere's own company. The character indeed was somewhat similar to his own. He judged severely of mankind; and could never conceal his disgust at the conversation of a fool, or his aversion to cunning and dissimulation. He was free from the affectation of science, and no one could know him to be a mathematician but from the accuracy of his thoughts. His conversation was general and instructive. Whatever he said was well digested and clearly expressed. His style possessed more strength and solidity than ornament and animation; but he was always correct, and he bestowed as much pains on his sentences as on his calculations. He could never endure any bold assertions or indecent witticisms against religion.

Moivre || Mole.

MOLA, an ancient town of Italy, in the kingdom of Naples, and in the Terra di Lavoro, where they pretend to show the ruins of Cicero's house. It is seated on the gulf of Venice, in E. Long. 17. 50. N. Lat. 41. 5.

Mola Salsa (Salt Cake), in antiquity, was barley parched, and afterwards ground to meal or flour, then mixed with salt and frankincense, with the addition of a little water. Thus prepared, it was sprinkled between the horns of the victim before it was killed in sacrifice. This act was called *immolatio*, and was common to the Greeks as well as Romans; with this difference, that the *mola* of the Romans was of wheat. The Greeks called it ϑλη or ϑλοχύλη.

MOLARES, or DENTES MOLARES, in *Anatomy*, the large teeth, called in English the *grinders*. See ANATOMY *Index*.

MOLASSES, or MOLOSSES. See MOLOSSES.

MOLDAVIA, a province of Turkey in Europe, bounded on the north-east by the river Niester, which divides it from Russia; on the east, by Bessarabia; on the south, by Walachia; and on the west, by Transylvania. It is 240 miles in length, and 150 in breadth. It has a good air and fruitful soil, producing corn, wine, rich pastures, a good breed of horses, oxen, sheep, plenty of game, fish, fowl, honey, wax, and all European fruits. Its principal rivers are the Danube, Niester, Pruth, Bardalach, and Sereth. The inhabitants are Christians of the Greek church, and Jassy is the principal town. It has been tributary to the Turks since the year 1574; who appoint a prince who is a native of the country, but have no regard to his being of the principal families. The prince is called Hospodar. The province pays a large yearly tribute to the Turkish government; besides raising a great body of horse at its own expence.

MOLE, a river in Surry, which has taken its name from running under ground. It first disappears at Boxhill, near Darking, in the county of Surry, and emerges again near Leatherhead.

MOLE. See TALPA, MAMMALIA *Index*; and for methods of destroying, see VERMIN, *Destruction of*.

MOLE, in *Midwifery*, a mass of fleshy matter, of a spherical

Mole, Moliere.

spherical figure, generated in the uterus, and sometimes mistaken for a child. See MIDWIFERY.

MOLE, or *Mark*. See NÆVUS.

MOLE, in *Architecture*, a massive work formed of large stones laid in the sea by means of coffer dams, extended either in a right line or an arch of a circle, before a port, which it serves to close; to defend the vessels in it from the impetuosity of the waves, and to prevent the passage of ships without leave. Thus we say the mole of the harbour of Messina, &c.

MOLE is sometimes also used to signify the harbour itself.

MOLE, (*moles*), among the Romans, was also used for a kind of mausoleum, built in manner of a round tower on a square base, insulate, encompassed with columns, and covered with a dome.—The mole of the emperor Adrian, now the castle of St Angelo, was the greatest and most stately of all the moles. It was crowned with a brazen pine apple, wherein was a golden urn containing the ashes of the emperor.

MOLE Cricket, See GRYLLOTALPA, ENTOMOLOGY *Index*.

MOLE Hills. These little hillocks of earth are a very great prejudice to the pasture lands, not only in wasting so much of the land as they cover, but in obstructing the scythe in mowing. In the west of England they use a peculiar instrument for the breaking up of these. It is a flat board, very thick, and of about eight inches in diameter, into which there is fastened a perpendicular handle of three or four feet long. It has four broad and sharp iron teeth at the front, which readily cut through the hill, and spread the earth it consists of; and behind there is a large knob proper for breaking the clods with, if there are any. Some use a spade, or other common instrument, in the place of this, but not so well. There is, however, a much better instrument even than this, for destroying these hills, where they are in very great numbers. This is a kind of horse machine; it has a sharp iron about three feet over, and with a strong back.—It is about four or five inches broad, and has two long handles for a horse to be harnessed to, and a cross bar of iron to strengthen it at the bottom of the handles, reaching from the one handle to the other. The middle of this cross bar is furnished with one, two, or more sharp pieces of iron like small ploughshares, to cut the mole hills into two, three, or more parts. The iron behind is of a semicircular figure. A single horse is harnessed to this machine, and a boy must be employed to drive it, and a man to hold and guide it; the sharp irons or shares are the first things that meet the hill, they run through it, break its texture, and cut it into several parts; and the circular iron following immediately behind them, cuts up the whole by the roots, and leaves the land level. This instrument will destroy as many mole hills in one day as a common labourer can do in eight, and would be of very great advantage to the kingdom if brought into general use.

MOLIERE, JOHN BAPTIST, a celebrated French comedian and dramatic writer, whose true name was *Pocquelin*, which for some reason he changed to that of Moliere. He was the son of a valet de chambre, and was born at Paris about the year 1620. He went through the study of the classics under the Jesuits in the college of Clermont, and was designed for the bar; but at his quitting the law schools, he made choice of the actor's profession. From a strong attachment to the drama, his whole study and application were directed to the stage, and he continued till his death to exhibit plays, which were greatly applauded. It is said the first motive of his going upon the stage was to enjoy the company of an actress for whom he had contracted a violent fondness. His comedies are highly esteemed. And it is no wonder he so justly represented domestic feuds, and the torments of jealous husbands, or of those who have reason to be so; for it is asserted that no man ever experienced this more than Moliere. His last comedy was *Le Malade Imaginaire*, which was brought on the stage in 1673; and Moliere died on the fourth night of its representation; some say in acting the very part of the pretended dead man, which gave some exercise for the wits of the time; but according to others he died in his bed that night, from the bursting of a vein in his lungs by coughing. The king, as a last mark of his favour, prevailed with the archbishop of Paris to suffer him to be buried in consecrated ground; though he had irritated the clergy by his *Tartuff*. The most esteemed editions of his works are that of Amsterdam, 5 vols. 12mo, 1699; and that of Paris, 6 vols. 4to, 1734.

Moliere || Mollugo.

MOLINISTS, in ecclesiastical history, a sect in the Romish church, who follow the doctrine and sentiments of the Jesuit Molina, relating to sufficient and efficacious grace. He taught that the operations of divine grace were entirely consistent with the freedom of human will; and he introduced a new kind of hypothesis to remove the difficulties attending the doctrines of predestination and liberty, and to reconcile the jarring opinions of Augustines, Thomists, Semi-Pelagians, and other contentious divines. He affirmed that the decree of predestination to eternal glory was founded upon a previous knowledge and consideration of the merits of the elect; that the grace, from whose operations these merits are derived, is not efficacious by its own intrinsic power only, but also by the consent of our own will, and because it is administered in those circumstances, in which the Deity, by that branch of his knowledge which is called *scientia media*, foresees that it will be efficacious. The kind of prescience, denominated in the schools *scientia media*, is that foreknowledge of future contingents that arises from an acquaintance with the nature and faculties of rational beings, of the circumstances in which they shall be placed, of the objects that shall be presented to them, and of the influence which their circumstances and objects must have on their actions.

MOLINOSISTS, a sect among the Romanists, who adhere to the doctrine of Molinos. These are the same with what are otherwise called *Quietests*, whose chief principle was, that men ought to annihilate themselves in order to be united to God, and afterwards remain in quietness of mind, without being troubled for what shall happen to the body. Molinos, the author of those opinions, was a Spanish priest, and was born in 1627. His 68 propositions were examined in 1687 by the pope and inquisitors, who decreed that his doctrine was false and pernicious, and that his books should be burned. He was forced to recant his errors publicly in the Dominican church, and was condemned to perpetual imprisonment. He was then 60 years old, and had been spreading his doctrine 22 years before. He died in prison in 1692.

MOLLUGO, AFRICAN CHICKWEED; a genus of plants

Molluga || Molosses.

plants belonging to the triandria class, and in the natural method ranking under the 22d order, *Caryophyllei*. See BOTANY *Index*.

MOLLUSCA, in the Linnæan system, one of the orders of vermes or worms. These are simple naked animals, not included in a shell, but furnished with limbs. See HELMINTHOLOGY *Index*.

MOLOCH, a false god of the Ammonites, who dedicated their children to him, by making them "pass through the fire," as the Scriptures express it. There are various opinions concerning this method of consecration. Some think, the children leaped over a fire sacred to Moloch; others, that they passed between two fires; and others, that they were really burnt in the fire, by way of sacrifice to this god. There is foundation for each of these opinions. For, first, it was usual among the pagans to lustrate or purify with fire; and, in the next place, it is expressly said, that the inhabitants of Sepharvaim burnt their children in the fire to Anamelech and Adramelech; much such deities as Moloch of the Ammonites.

Moses, in several places, forbids the Israelites to dedicate their children to this god as the Ammonites did, and threatens death and utter extirpation to such persons as were guilty of this abominable idolatry. And there is great probability that the Hebrews were much addicted to the worship of this deity: since Amos, and after him St Stephen, reproaches them with having carried along with them into the wilderness the tabernacle of their god Moloch.

Solomon built a temple to Moloch upon the mount of Olives; and Manasseh, a long time after, imitated his impiety, by making his son pass through the fire in honour of Moloch. It was chiefly in the valley of Tophet and Hinnom, to the east of Jerusalem, that the Israelites paid their idolatrous worship to this false god of the Ammonites.

There are various sentiments concerning the relation which Moloch had to the other pagan divinities. Some believe he was the same with Saturn, to whom it is well known that human sacrifices were offered. Others suppose him to be Mercury; others, Mars; others, Mithras; and others, Venus. Lastly, Others take Moloch to be the sun, or the king of heaven. Moloch was likewise called *Milcom*; as appears from what is said of Solomon, that he went after Ashtaroth the abomination of the Zidonians, and Milcom the abomination of the Ammonites.

MOLOSSES, MOLASSES, or *Melasses*, that gross fluid matter remaining of sugar after refining, and which no boiling will bring to a consistence more solid than that of syrup; hence also called *syrup of sugar*.

Properly, molosses are only the sediment of one kind of sugar called *chypre*, or brown sugar, which is the refuse of other sugars not to be whitened or reduced into loaves.

Molosses are much used in Holland for the preparation of tobacco, and also among poor people instead of sugar. There is a kind of brandy or spirit made of molosses; but by some held exceedingly unwholesome. See below.

Artificial MOLOSSES. There has been found a method of making molosses from apples without the addition of sugar. The apple that succeeds best in this operation is a summer sweeting of a middle size, pleasant to the taste, and so full of juice that seven bushels will yield a barrel of cyder. Molosses || Molucca Islands.

The manner of making it is this: the apples are to be ground and pressed, then the juice is to be boiled in a large copper, till three quarters of it be evaporated: this will be done with a moderate fire in about six hours, with the quantity of juice above mentioned; by this time it will be of the consistence and taste as well as of the colour of molosses.

This new molosses serves all the purposes of the common kind, and is of great use in preserving cyder. Two quarts of it put into a barrel of racked cyder, will preserve it, and give it an agreeable colour.

The invention of this kind of molosses was owing to Mr Chandler of Woodstock in New England, who living at a distance from the sea, and where the common molosses was very dear and scarce, provided this for the supply of his own family, and introduced the practice among people of the neighbourhood. It is to be observed, that this sort of apple, the sweeting, is of great use in making cyder; one of the very best kinds we know being made of it. The people in New England also feed their hogs with the fallings of their orchards of these apples; and the consequence of this is, that their pork is the finest in the world.

Molosses Spirit; a very clean and pure spirit, much used in England, and made from molosses or common treacle dissolved in water, and fermented in the same manner as malt or the common malt spirit. See DISTILLATION.

MOLOSSI, a people of Epirus, who inhabited that part of the country which was called *Molossia*, or *Molossus*, from King Molossus, a son of Pyrrhus and Andromache. This country had the bay of Ambracia on the south, and the country of the Perrhæbeans on the east. The dogs of the place were famous, and received the name of *Molossi* among the Romans. Dodona was the capital of the country, according to some writers. Others, however, reckon it as the chief city of Thesprotia.

MOLOSSUS, in the Greek and Latin poetry, a foot consisting of three long syllables. As *audiri*, *cantabant*, *virtutem*.

It takes its name either from a dance in use among the people called *Molossi* or *Epirotæ*; or from the temple of Jupiter Molossus, where odes were sung, in which this foot had a great share; or else because the march of the Molossi, when they went to the combat, was composed of these feet, or had the cadence thereof. The same foot was also called among the ancients, *Vertumnus*, *extensipes*, *hippius*, *et cannius*.

MOLUCILLA, a genus of plants belonging to the didynamia class, and in the natural method ranking under the 42d order, *Verticillatæ*. See BOTANY *Index*.

MOLTEN-GREASE. See FARRIERY, N° 499.

MOLUCCA ISLANDS, lie in the East Indian sea under the line; of which there are five principal, namely, Ternate, Tydor, Machian, Motyr, and Bachian. The largest of them is hardly 30 miles in circumference. They produce neither corn, rice, nor cattle, except goats: but they have oranges, lemons, and other fruits; and are most remarkable for spices, especially cloves. They have large snakes, which are not venomous, and very dangerous land crocodiles. At present they have three kings; and the Dutch, who

are

Molosses || Momus.

are very strong here, keep out all other European nations, being jealous of their spice trade. The religion is idolatry; but there are many Mahometans. They were discovered by the Portuguese in 1511, who settled upon the coast; but the Dutch drove them away, and are now the masters of all these islands.

MOLWITZ, a town of Silesia, in the province of Grotska, remarkable for a battle gained by the Prussians over the Austrians in 1741. E. Long. 16. 45. N. Lat. 50. 26.

MOLY. The name of this plant is rendered famous by Homer: and hence has been much inquired into, as to its true sense, by the botanists of almost all times. The old interpreters of Homer explain this word by the "wild rue;" and the only reason for this is, that at some time, probably long after the days of Homer, the people of Cappadocia called the wild rue *moly*. But this plant is wholly different from the moly of Homer, which Theophrastus affirms grew in his time in Areadia in great plenty, and had a round bulbous root like an onion, and long and grassy leaves like the squill. On the whole, the moly of Homer seems to have been a species of allium or garlic.

MOLYBDENA, a metal. See CHEMISTRY and MINERALOGY *Index*.

MOMBAZA, or MONBAZA, a town of Africa, in an island of the same name, with a castle and a fort; seated on the eastern coast, opposite to the country of Mombaza in Zanguebar, 75 miles south of Melinda, and subject to Portugal. E. Long. 39. 30. S. Lat. 3. 15.

MOMBAZA, a country of Africa in Zanguebar, subject to the Portugese, from whence they export slaves, gold, ivory, rice, flesh, and other provisions, with which they supply the settlements in Brasil. The king of this country being a Christian, had a quarrel with the Portuguese governor, took the castle by assault in 1631, turned Mahometan, and murdered all the Christians; but in 1729 they became masters of the territory again.

MOMENT, in the doctrine of time, an instant, or the most minute and indivisible part of duration.

MOMENTUM, in *Mechanics*, signifies the same with impetus, or the quantity of motion in a moving body; which is always equal to the quantity of matter multiplied into the velocity; or, which is the same thing, it may be considered as a rectangle under the quantity of matter and velocity. See MECHANICS.

MOMORDICA, MALE BALSAM APPLE; a genus of plants belonging to the monœcia class; and in the natural method ranking under the 34th order, *Cucurbitaceæ*. See BOTANY *Index*.

MOMUS, in fabulous history, the god of raillery, or the jester of the celestial assembly, and who ridiculed both gods and men. Being chosen by Vulcan, Neptune, and Minerva, to give his judgment concerning their works, he blamed them all: Neptune for not making his bull with horns before his eyes, in order that he might give a surer blow; Minerva for building a house that could not be removed in case of bad neighbours; and Vulcan, for making a man without a window in his breast, that his treacheries might be seen. For his free reflections upon the gods, Momus was driven from heaven. He is generally represented raising a mask from his face, and holding a small figure in his hand.

Mona || Monarchy.

MONA, in *Ancient Geography*, two islands of this name in the sea lying between Britain and Ireland. The one described by Cæsar, as situated in the middle passage between both islands, called *Monaæda* (Ptolemy); *Monapia*, or *Monabia* (Pliny), is supposed to be the isle of Man.—Another Mona (Tacitus); an island more to the south, separated from the coast of the Ordovices by a narrow strait. The ancient seat of the Druids. Now called *Anglesey*, the island of the Angles or English.

MONA, an island of the Baltic sea, south-west of the island of Zealand, subject to Denmark. E. Long. 12. 30. N. Lat. 55. 20.

MONA. See INCHCOLM.

MONACA, a small but handsome and strong town of Italy, in the territory of Genoa, with a castle, citadel, and a good harbour. It is seated on a craggy rock, and had its own prince, under the protection of France. It was united to France early in the Revolution, but its independence was restored by the peace of Paris in 1814. E. Long. 7. 33. N. Lat. 43. 48.

MONAD. See *LEIBNITZIAN Philosophy*.

MONADELPHIA, (from μονος, *alone*, and αδελφια, a *brotherhood*;) a "single brotherhood:" The name of the 16th class in Linnæus's sexual system, consisting of plants with hermaphrodite flowers; in which all the stamina are united below into one body or cylinder, through which passes the pistillum. See BOTANY *Index*.

MONAGHAN, a county of Ireland, situated in the province of Ulster, is bounded by Tyrone on the north, Armagh on the east, Cavan and Louth on the south, and Fermanagh on the west. It is a mountainous tract, but in some places is well improved. It contains 170,090 Irish plantation acres, and is about 30 miles long and 22 broad. It has a considerable linen trade, and sends two members to parliament.

MONAGHAN, the capital town of the county of that name, is distant 62 miles from Dublin, and gives title of baron to the family of Blayney. It was anciently called *Muinechan*. An abbey was founded here in a very early age, of which Moelodius the son of Aodh was abbot. In 1462, a monastery for conventual Franciscans was erected on the site of this abbey, which was granted on the general suppression of monasteries to Edward Withe, and a castle has been since erected on the site by Edward Lord Blayney.

MONANDRIA, (from μονος, *alone*, and ανηρ, a *man* or *husband*), the name of the first class in Linnæus's sexual system; consisting of plants with hermaphrodite flowers, which have only one stamen.

MONARCHY, a large state governed by one; or a state where the supreme power is lodged in the hands of a single person. The word comes from the Greek μοναρχης, "one who governs alone;" formed of μονος, *solus*, and αρχη, *imperium*, "government." Of the three forms of government, viz. democracy, aristocracy, and monarchy, the last is the most powerful, all the sinews of government being knit together, and united in the hand of the prince; but then there is imminent danger of his employing that strength to improvident or oppressive purposes. As a democracy is the best calculated to direct the end of a law, and an aristocracy to invent the means by which that end shall be obtained, a monarchy is most fit for carrying those means into execution.

Monarchy. The most ancient monarchy was that of the Assyrians, which was founded soon after the deluge. We usually reckon four grand or universal monarchies; the Assyrian, Persian, Grecian, and Roman; though St Augustine makes them but two; viz. those of Babylon and Rome. Belus is placed at the head of the series of Assyrian kings who reigned at Babylon, and is by profane authors esteemed the founder of it, and by some the same whom the Scriptures call Nimrod. The principal Assyrian kings after Belus were Ninus, who built Nineveh, and removed the seat of empire to it; Semiramis, who disguising her sex, took possession of the kingdom instead of her son, and was killed and succeeded by her son Ninyas; and Sardanapalus, the last of the Assyrian monarchs, and more effeminate than a woman. After his death the Assyrian empire was split into three separate kingdoms, viz. the Median, Assyrian, and Babylonian. The first king of the Median kingdom was Arbaces; and this kingdom lasted till the time of Astyages, who was subdued and divested of his kingdom by Cyrus.

In the time of Cyrus there arose a new and second monarchy called the Persian, which stood upwards of 200 years from Cyrus, whose reign began A. M. 3468, to Darius Codomannus, who was conquered by Alexander, and the empire translated to the Greeks A. M. 3674.—The first monarch was Cyrus, founder of the empire. 2. Cambyses, the son of Cyrus. 3. Smerdis. 4. Darius, the son of Hystaspis, who reigned 521 years before Christ. 5. Xerxes, who reigned 485 years before Christ. 6. Artaxerxes Longimanus, who reigned 464 years before Christ. 7. Xerxes, the second. 8. Ochus, or Darius, called Nothus, 424 years before Christ. 9. Artaxerxes Mnemon, 405 years before Christ. 10. Artaxerxes Ochus, 359 years before Christ. 11. Arses, 338 years before Christ. 12. Darius Codomannus, 336 years before Christ, who was defeated by Alexander the Great, and deprived of his kingdom and life about 331 years before Christ: the dominion of Persia after his death was translated to the Greeks.

The third monarchy was the Grecian. As Alexander, when he died, did not declare who should succeed him, there started up as many kings as there were commanders. At first they governed the provinces that were divided among them under the title of viceroys; but when the family of Alexander the Great was extinct, they took upon them the name of kings. Hence, in process of time, the whole empire of Alexander produced four distinct kingdoms, viz. 1. The Macedonian; the kings of which, after Alexander, were Antipater, Cassander, Demetrius Poliorcetes, Seleucus Nicanor, Meleager, Antigonus Doson, Philip, and Perseus, under whom the Macedonian kingdom was reduced to the form of a Roman province. 2. The Asiatic kingdom, which upon the death of Alexander fell to Antigonus, comprehending that country now called Natolia, together with some other regions beyond Mount Taurus. From this kingdom proceeded two lesser ones, viz. that of Pergamus, whose last king, Attalus, appointed the Roman people to be his heir; and Pontus, reduced by the Romans into the form of a province, when they had subdued the last king, Mithridates. 3. The Syrian, of whose twenty-two kings the most celebrated were, Seleucus Nicanor, founder of kingdom; Antiochus Deus; Antiochus the Great; Antiochus Epiphanes; and Tigranes, who was conquered by the Romans under Pompey, and Syria reduced into the form of a Roman province. 4. The Egyptian, which was formed by the Greeks in Egypt, and flourished near 240 years under 12 kings, the principal of whom were, Ptolemy Lagus, its founder; Ptolemy Philadelphus, founder of the Alexandrian library; and Queen Cleopatra, who was overcome by Augustus, in consequence of which Egypt was added to the dominion of the Romans. Monarchy || Monastere van.

The fourth monarchy was the Roman, which lasted 1244 years, from the building of the city until the time when the royal power was abrogated. The kings of Rome were Romulus, its founder; Numa Pompilius; Tullus Hostilius; Ancus Martius; Tarquinius Priscus; Servius Tullius; and Tarquin the Proud, who was banished, and with whom terminated the regal power.

There seems in reality no necessity to make the Medes, Persians, and Greeks, succeed to the whole power of the Assyrians, to multiply the number of the monarchies. It was the same empire still; and the several changes that happened in it did not constitute different monarchies. Thus the Roman empire was successively governed by princes of different nations, yet without any new monarchy being formed thereby. Rome, therefore, may be said to have immediately succeeded Babylon in the empire of the world. See EMPIRE.

Of monarchies some are absolute and despotic, where the will of the monarch is uncontroulable; others are limited, where the prince's authority is restrained by laws, and part of the supreme power lodged in other hands, as in Britain. See GOVERNMENT.

Some monarchies again are hereditary, where the succession devolves immediately from father to son; and others are elective, where, on the death of the monarch, his successor is appointed by election, as in Poland.

Fifth-Monarchy Men, in the ecclesiastical history of England, were a set of wronged-headed and turbulent enthusiasts who arose in the time of Cromwell, and who expected Christ's sudden appearance upon earth to establish a new kingdom; and, acting in consequence of this illusion, aimed at the subversion of all human government.

MONARDA, INDIAN HOREHOUND, a genus of plants belonging to the diandria class; and in the natural method ranking under the 42d order, *Verticillatæ*. See BOTANY *Index*.

MONASTEREVAN, a post town of Ireland, in the county of Kildare and province of Leinster, 36 miles from Dublin, so called from a magnificent abbey which was founded here, in which St Evan in the beginning of the 7th century placed a number of monks from South Munster, and which had the privilege of being a sanctuary. The consecrated bell, which belonged to this saint, was on solemn trials sworn upon by the whole tribe of the Eoganachts, and was always committed to the care of the Mac Evans, hereditary chief justices of Munster. The abbot of this house sat as a baron in parliament.—At the general suppression of monasteries, this abbey was granted to Lord Audley, who assigned it to Viscount Ely. It afterwards came into

Monasterevan, Monastery.

into the family of Moor, earls of Drogheda, and has been beautifully repaired by the present Lord Drogheda, still wearing the venerable appearance of an abbey. There is a nursery at Monasterevan for the charter schools of the province of Leinster; and the grand canal has been carried up to this town from Dublin, since which it has been much improved and enlarged with several new buildings.

MONASTERY, a convent or house built for the reception of religious; whether it be abbey, priory, nunnery, or the like.

MONASTERY is only properly applied to the houses of monks, mendicant friars, and nuns. The rest are more properly called *religious houses*. For the origin of monasteries, see MONASTIC and MONK.

The houses belonging to the several religious orders which obtained in England and Wales were, cathedrals, colleges, abbeys, priories, preceptories, commandries, hospitals, friaries, hermitages, chantries, and free chapels. These were under the direction and management of various officers. The dissolution of houses of this kind began so early as the year 1312, when the Templars were suppressed; and in 1323 their lands, churches, advowsons, and liberties, here in England, were given by 17 Ed. II. st. 3. to the prior and brethren of the hospital of St John at Jerusalem. In the years 1390, 1437, 1441, 1459, 1497, 1505, 1508, and 1515, several other houses were dissolved, and their revenues settled on different colleges in Oxford and Cambridge. Soon after the last period, Cardinal Wolsey, by license of the king and pope, obtained a dissolution of above 30 religious houses for the founding and endowing his colleges at Oxford and Ipswich. About the same time a bull was granted by the same pope to Cardinal Wolsey to suppress monasteries, where there were not above six monks, to the value of 8000 ducats a-year, for endowing Windsor and King's College in Cambridge; and two other bulls were granted to Cardinals Wolsey and Campeius, where there were less than twelve monks, and to annex them to the greater monasteries; and another bull to the same cardinals to inquire about abbeys to be suppressed in order to be made cathedrals. Although nothing appears to have been done in consequence of these bulls, the motives which induced Wolsey and many others to suppress these houses was the desire of promoting learning; and Archbishop Cranmer engaged in it with a view of carrying on the Reformation. There were other causes that concurred to bring on their ruin: many of the religious were loose and vicious; the monks were generally thought to be in their hearts attached to the pope's supremacy; their revenues were not employed according to the intent of the donors; many cheats in images, feigned miracles, and counterfeit relicks, had been discovered, which brought the monks into disgrace; the Observant friars had opposed the king's divorce from Queen Catharine; and these circumstances operated, in concurrence with the king's want of a supply and the people's desire to save their money, to forward a motion in parliament, that in order to support the king's state and supply his wants, all the religious houses might be conferred upon the crown which were not able to spend above 200l. a-year; and an act was passed for that purpose 27 Hen. VIII. c. 28. By this act about 380 houses were dissolved, and a revenue of 30,000l. or 32,000l. a-year came to the crown; besides about 100,000l. in plate and jewels. The suppression of these houses occasioned discontent, and at length an open rebellion: when this was appeased, the king resolved to suppress the rest of the monasteries, and appointed a new visitation: which caused the greater abbeys to be surrendered apace; and it was enacted by 31 Henry VIII. c. 13. that all monasteries, &c. which have been surrendered since the 4th of February, in the 27th year of his majesty's reign, and which hereafter shall be surrendered, shall be vested in the king. The knights of St John of Jerusalem were also suppressed by the 32 Henry VIII. c. 24. The suppression of these greater houses by these two acts produced a revenue to the king of above 100,000l. a-year, besides a large sum in plate and jewels. The last act of dissolution in this king's reign was the act of 37 Henry VIII. c. 4. for dissolving colleges, free chapels, chantries, &c. which act was farther enforced by 1 Edw. VI. c. 14. By this act were suppressed 90 colleges, 110 hospitals, and 2374 chantries and free chapels. The number of houses and places suppressed from first to last, so far as any calculations appear to have been made, seems to be as follow:

Monastery.

Of lesser monasteries, of which we have the valuation,	374
Of greater monasteries,	186
Belonging to the hospitallers,	48
Colleges,	90
Hospitals,	110
Chantries and free chapels,	2374
Total	3182

Besides the friars houses and those suppressed by Wolsey, and many small houses of which we have no particular account.

The sum total of the clear yearly revenue of the several houses at the time of their dissolution, of which we have any account, seems to be as follow:

Of the greater monasteries,	L.104,919.	13	3½
Of all those of the lesser monasteries of which we have the valuation,	29,702	1	10½
Knights hospitallers head house in London,	2385	12	8
We have the valuation of only 28 of their houses in the country,	3026	9	5
Friars houses of which we have the valuation,	751	2	0½
Total	L.140,784	19	3½

If proper allowances are made for the lesser monasteries and houses not included in this estimate, and for the plate, &c. which came into the hands of the king by the dissolution, and for the value of money at that time, which was at least six times as much as at present, and also consider that the estimate of the lands was generally supposed to be much under the real worth, we must conclude their whole revenues to have been immense.

It does not appear that any computation hath been made of the number of persons contained in the religious houses.

These

Monastery, Monastic.

Those of the lesser monasteries dissolved by 27 Hen. VIII. were reckoned at about	10,000
If we suppose the colleges and hospitals to have contained a proportionable number, these will make about	5347
If we reckon the number in the greater monasteries, according to the proportion of their revenues, they will be about 35,000; but as probably they had larger allowances in proportion to their number than those of the lesser monasteries, if we abate upon that account 5000, they will then be	30,000
One for each chantry and free chapel,	2374
Total,	47,721

But as there were probably more than one person to officiate in several of the free chapels, and there were other houses which are not included within this calculation, perhaps they may be computed in one general estimate at about 50,000. As there were pensions paid to almost all those of the greater monasteries, the king did not immediately come into the full enjoyment of their whole revenues: however, by means of what he did receive, he founded six new bishoprics, viz. those of Westminster (which was changed by Queen Elizabeth into a deanery, with twelve prebends and a school), Peterborough, Chester, Gloucester, Bristol, and Oxford. And in eight other sees he founded deaneries and chapters, by converting the priors and monks into deans and prebendaries, viz. Canterbury, Winchester, Durham, Worcester, Rochester, Norwich, Ely, and Carlisle. He founded also the colleges of Christ-church in Oxford and Trinity in Cambridge, and finished King's college there. He likewise founded professorships of divinity, law, physic, and of the Hebrew and Greek tongues, in both the said universities. He gave the house of Greyfriars and St Bartholomew's hospital to the city of London, and a perpetual pension to the poor knights of Windsor, and laid out great sums in building and fortifying many ports in the channel. It is observable, upon the whole, that the dissolution of these houses was an act, not of the church, but of the state; in the period preceding the Reformation, by a king and parliament of the Roman catholic communion in all points except the king's supremacy; to which the pope himself, by his bulls and licenses, had led the way.

MONASTIC, something belonging to monks, or the monkish life. The monastic profession is a kind of civil death, which in all worldly matters has the same effect with the natural death. The council of Trent, &c. fix sixteen years for the age at which a person may be admitted into the monastical state.

St Anthony is the person who, in the fourth century, first instituted the monastic life; as St Pachomius, in the same century, is said to have first set on foot the cœnobitic life, *i. e.* regular communities of religious. In a short time the deserts of Egypt became inhabited with a set of solitaries, who took upon them the monastic profession. St Basil carried the monkish humour into the east, where he composed a rule which afterwards obtained through a great part of the west.

In the 11th century the monastic discipline was grown very remiss. St Odo first began to retrieve it in the monastery of Cluny; that monastery, by the conditions of its erection, was put under the immediate protection of the holy see; with a prohibition to all powers, both secular and ecclesiastical, to disturb the monks in the possession of their effects or the election of their abbot. In virtue hereof they pleaded an exemption from the jurisdiction of the bishop, and extended this privilege to all the houses dependent on Cluny. This made the first congregation of several houses, under one chief immediately subject to the pope, so as to constitute one body, or, as they now call it, one *religious order*. Till then, each monastery was independent and subject to the bishop. See MONK.

Monastic || Monetarius.

MONDA, or MUNDA, in *Ancient Geography*, a river of Lusitania, running mid-way from east to west into the Atlantic, between the Durius and Tagus, and washing Conimbrica. Now the *Mondego*, a river of Portugal, which running by Coimbra, falls into the Atlantic, 30 miles below it.

MONDAY, the second day of the week, so called as being anciently sacred to the moon; *q. d.* moon-day.

MONDOVI, a considerable town of Italy, in Piedmont; with a citadel, university, and bishop's see. It belongs to the king of Sardinia, is large and populous, and is seated in E. Long. 7. 40. N. Lat. 44. 33.

MONEMUGI, an empire in the south of Africa, has Zanguebar on the east, Monomotapa on the south, Motamba and Makoko on the west, and Abyssinia on the north and partly to the east, though its boundaries that way cannot be ascertained. It is divided into the kingdoms of Mujaco, Makoko or Ansiko, Gingiro, Cambate, Alaba, and Monemugi Proper. This last lies in the middle of the torrid zone, and about the equinoctial line, south of Makoko, west of Zanguebar, north of Monomotapa, and east of Congo and of the northern parts of Monomotapa. The country known, abounds with gold, silver, copper mines, and elephants. The natives clothe themselves in silks and cottons, which they buy of strangers, and wear collars of transparent amber beads, brought them from Cambaya: which beads serve also instead of money; gold and silver being too common, and of little value among them.

Their monarch always endeavours to be at peace with the princes round about him, and to keep an open trade with Quitoa, Melinda, and Mombaza, on the east, and with Congo on the west: from all which places the black merchants resort thither for gold. The Portuguese merchants report, that on the east side of Monemugi there is a great lake full of small islands, abounding with all sorts of fowl and cattle, and inhabited by negroes. They relate also, that on the main land eastward they heard sometimes the ringing of bells, and that one could observe buildings very much like churches; and that from these parts came men of a brown and tawney complexion, who traded with those islanders, and with the people of Monemugi. This country abounds in palm wine, oil, and honey.

MONETARIUS, or MONEYER, a name which antiquaries and medallists give to those who struck the ancient coins or moneys.

Many of the old Roman, &c. coins have the name of the *monetarius*, either written at length, or at least the initial letters of it. See MEDAL.

MONEY.

Money. MONEY, a piece of matter, commonly metal, to which public authority has affixed a certain value and weight to serve as a medium in commerce. See COIN, COMMERCE, MEDALS, and BANK; also the articles BANKING, COINAGE, and EXCHANGE, in the SUPPLEMENT.

Money is usually divided into *real* or *effective*, and *imaginary* or *money of account*,

I. *REAL Money.*

1. *History of real money.* Real money includes all coins, or species of gold, silver, copper, and the like; which have course in common, and do really exist. Such are guineas, pistoles, pieces of eight, ducats, &c.

Real money, civilians observe, has three essential qualities, viz. matter, form, and weight or value.

For the matter, copper is that thought to have been first coined; afterwards silver; and lastly gold, as being the most beautiful, scarce, cleanly, divisible, and pure of all metals.

The degrees of goodness are expressed in gold by carats; and in silver by pennyweights, &c. For there are several reasons for not coining them pure and without alloy, viz. the great loss and expence in refining them, the necessity of hardening them to make them more durable, and the scarcity of gold and silver in most countries. See ALLOY.

Among the ancient Britons, iron rings, or, as some say, iron plates, were used for money; among the Lacedæmonians, iron bars quenched with vinegar, that they might not serve for any other use. Seneca observes, that there was anciently stamped money of leather, *corium forma publica impressum.* And the same thing was put in practice by Frederic II. at the siege of Milan; to say nothing of an old tradition among ourselves, that in the confused times of the barons wars the like was done in England: but the Hollanders, we know, coined great quantities of pasteboard in the year 1574.

As to the form of money, it has been more various than the matter. Under this are comprehended the weight, figure, impression, and value.

For the impression, the Jews, though they detested images, yet stamped on the one side of their shekel the golden pot which held the manna, and on the other Aaron's rod. The Dardans stamped two cocks fighting. The Athenians stamped their coins with an owl, or an ox; whence the proverb on bribed lawyers, *Bos in lingua.* They of Ægina, with a tortoise; whence, that other saying, *Virtutem et sapientiam vincunt testudines.* Among the Romans, the monetarii sometimes impressed the images of men that had been eminent in their families on the coins: but no living man's head was ever stamped on a Roman coin till after the fall of the commonwealth. From that time they bore the emperor's head on one side. From this time the practice of stamping the prince's image on coins has obtained among all civilized nations; the Turks and other Mahometans alone excepted, who, in detestation of images, inscribe only the prince's name, with the year of the transmigration of their prophet.

As to the figure, it is either round as in Britain; multangular or irregular, as in Spain; square, as in some parts of the Indies; or nearly globular, as in most of the rest. Money.

After the arrival of the Romans in this island, the Britons imitated them, coining both gold and silver with the images of their kings stamped on them. When the Romans had subdued the kings of the Britons, they also suppressed their coins, and brought in their own; which were current here from the time of Claudius to that of Valentinian the Younger, about the space of 500 years.

Mr Camden observes, that the most ancient English coin he had known was that of Ethelbert king of Kent, the first Christian king in the island; in whose time all money accounts begin to pass by the names of *pounds, shillings, pence*, and *mancuses.* Pence seems borrowed from the Latin *pecunia*, or rather from *pendo*, on account of its just weight, which was about threepence of our money. These were coarsely stamped with the king's image on the one side, and either the mint master's, or the city's where it was coined, on the other. Five of these pence made their schilling, probably so called from *scilingus*, which the Romans used for the fourth part of an ounce. Forty of these schillings made their pound; and 400 of these pounds were a legacy, or portion for a king's daughter, as appears by the last will of King Alfred. By these names they translated all sums of money in their Old English testament; talents by *pundes;* Judas's thirty pieces of silver by *thirtig scillinga;* tribute money, by *penninga;* the mite by *feorthling.*

But it must be observed, they had no other real money, but pence only; the rest being imaginary moneys, i. e. names of numbers or weights. Thirty of these pence made a maneus, which some take to be the same with a mark: manea, as appears by an old MS. was *quinta pars unciæ.* These mancas or mancuses were reckoned both in gold and silver. For in the year 680 we read that Ina king of the West Saxons obliged the Kentishmen to buy their peace at the price of 30,000 mancas of gold. In the notes on King Canute's laws, we find this distinction, that *mancusa* was as much as a mark of silver, and *manca*, a square piece of gold, valued at 30 pence.

The Danes introduced a way of reckoning money by ores, *per oras*, mentioned in Domesday book; but whether they were a several coin, or a certain sum, does not plainly appear. This, however, may be gathered from the Abbey book of Burton, that 20 ores were equivalent to two marks. They had also a gold coin called *byzantine*, or *bezant*, as being coined at Constantinople, then called *Byzantium.* The value of which coin is not only now lost, but was so entirely forgot even in the time of King Edward III. that whereas the bishop of Norwich was fined a byzantine of gold to be paid the abbot of St Edmund's Bury for infringing his liberties (as it had been enacted by parliament in the time of the Conqueror), no man then living could tell how much it was; so it was referred to the king to rate how much he should pay. Which is the more unaccountable, because but 100 years before, 200,000 bezants were exacted by the soldan for the ransom of St Louis of France: which were then valued at 100,000 livres.

Though the coining of money be a special preroga-

tive

Money. tive of the king, yet the ancient Saxon princes communicated it to their subjects; insomuch that in every good town there was at least one mint; but at London eight; at Canterbury four for the king, two for the archbishop, one for the abbot at Winchester, six at Rochester, at Hastings two, &c.

The Norman kings continued the same custom of coining only pence, with the prince's image on one side, and on the other the name of the city where it was coined, with a cross so deeply impressed, that it might be easily parted and broke into two halves, which, so broken, they called *halfpence;* or into four parts, which they called *fourthings* or *farthings*.

In the time of King Richard I. money coined in the east-parts of Germany came in special request in England on account of its purity, and was called *easterling money*, as all the inhabitants of those parts were called *Easterlings*. And shortly after, some of those people skilled in coining were sent for hither, to bring the coin to perfection; which since has been called *sterling* for *Easterling*. See STERLING.

King Edward I. who first adjusted the measure of an ell by the length of his arm, herein imitating Charles the Great, was the first also who established a certain standard for the coin, which is expressed to this effect by Greg. Rockley, mayor of London, and mint master.—"A pound of money containeth twelve ounces: in a pound there ought to be eleven ounces, two easterlings, and one farthing; the rest alloy. The said pound ought to weigh twenty shillings and three pence in account and weight. The ounce ought to weigh twenty pence, and a penny twenty-four grains and a half. Note, That eleven ounces two pence sterling ought to be of pure silver, called *leaf silver*; and the minter must add of other weight seventeen pence halfpenny farthing, if the silver be so pure."

About the year 1320, the states of Europe first began to coin gold; and among the rest, our King Edward III. The first pieces he coined were called *florences*, as being coined by Florentines: afterwards he coined nobles; then rose-nobles, current at 6s. 8d. half nobles called *half pennies*, at 3s. 4d. of gold; and quarters at 20d. called *farthings of gold*. The succeeding kings coined rose-nobles, and double rose-nobles, great sovereigns, and half Henry nobles, angels, and shillings.

King James I. coined units, double crowns, Britain crowns: then crowns, half-crowns, &c.

2. *Comparative value of Money and Commodities at different periods.* The English money, though the same names do by no means correspond with the same quantity of precious metal as formerly, has not changed so much as the money of most other countries. From the time of William the Conqueror, the proportion between the pound, the shilling, and the penny, seems to have been uniformly the same as at present.

Edward III. as already mentioned, was the first of our kings that coined any gold; and no copper was coined by authority before James I. These pieces were not called farthings, but *farthing tokens*, and all people were at liberty to take or refuse them. Before the time of Edward III. gold was exchanged, like any other commodity, by its weight; and before the time of James I. copper was stamped by any one person who chose to do it.

In the years 712 and 727, a ewe and lamb were rated at 1s. Saxon money till a fortnight after Easter. Between the years 900 and 1000, two hydes of land, each containing about 120 acres, were sold for 100 shillings. In 1000, by King Ethelred's laws, a horse was rated at 30s. a mare or a colt of a year old, at 20s. a mule or young ass, at 12s. an ox at 30s. a cow at 24s. a swine at 8d. a sheep at 1s. In 1043, a quarter of wheat was sold for 60d. Hence it is computed, that in the Saxon times there was ten times less money, in proportion to commodities, than at present. Their nominal specie, therefore, being about three times higher than ours, the price of every thing, according to our present language, must be reckoned thirty times cheaper than it is now. Money.

In the reign of William the Conqueror, commodities were ten times cheaper than they are at present; from which we cannot help forming a very high idea of the wealth and power of that king: for his revenue was 400,000l. per annum, every pound being equal to that weight of silver, consequently the whole may be estimated at 1,200,000l. of the present computation; a sum which, considering the different value of money between that period and the present, was equivalent to 12,000,000l. of modern estimation.

The most necessary commodities do not seem to have advanced their price from William the Conqueror to Richard I.

The price of corn in the reign of Henry III. was near half the mean price in our times. Bishop Fleetwood has shown, that in the year 1240, which was in this reign, 4l. 13s. 9d. was worth about 50l. of our present money. About the latter end of this reign, Robert de Hay, rector of Souldern, agreed to receive 100s. to purchase to himself and successor the annual rents of 5s. in full compensation of an acre of corn.

Butchers meat, in the time of the great scarcity in the reign of Edward II. was, by a parliamentary ordinance, sold three times cheaper than our mean price at present; poultry somewhat lower, because being now considered as a delicacy, it has risen beyond its proportion. The mean price of corn at this period was half the present value, and the mean price of cattle one-eighth.

In the next reign, which was that of Edward III. the most necessary commodities were in general about three or four times cheaper than they are at present.

In these times, knights, who served on horseback in the army, had 2s. a-day, and a foot archer 6d. which last would now be equal to a crown a-day. This pay has continued nearly the same nominally (only that in the time of the commonwealth the pay of the horse was advanced to 2s. 6d. and that of the foot 1s. though it was reduced again at the Restoration), but soldiers were proportionably of a better rank formerly.

In the time of Henry VI. corn was about half its present value, other commodities much cheaper. Bishop Fleetwood has determined, from a most accurate consideration of every circumstance, that 3l. in this reign was equivalent to 28l. or 30l. now.

In the time of Henry VII. many commodities were three times as cheap here, and in all Europe, as they are at present, there having been a great increase of gold and silver in Europe since his time occasioned by the discovery of America.

The commodities whose price has risen the most since before the time of Henry VII. are butchers meat, fowls,

Money. fowls, and fish, especially the latter. And the reason why corn was always much dearer in proportion to other eatables, according to their prices at present, is, that in early times agriculture was little understood. It required more labour and expence, and was more precarious than it is at present. Indeed, notwithstanding the high price of corn in the times we are speaking of, the raising of it so little answered the expence, that agriculture was almost universally quitted for grazing; which was more profitable, notwithstanding the low price of butchers meat. So that there was constant occasion for statutes to restrain grazing, and to promote agriculture; and no effectual remedy was found till the bounty upon the exportation of corn; since which, above ten times more corn has been raised in this country than before.

The price of corn in the time of James I. and consequently that of other necessaries of life, was not lower, but rather higher, than at present: wool is not two-thirds of the value it was then; the finer manufactures having sunk in price by the progress of art and industry, notwithstanding the increase of money. Butchers meat was higher than at present. Prince Henry made an allowance of near 4d. per pound for all the beef and mutton used in his family. This may be true with respect to London; but the price of butchers meat in the country, which does not even now much exceed this price at a medium, has certainly greatly increased of late years, and particularly in the northern counties.

The prices of commodities are higher in England than in France; besides that the poor people of France live upon much less than the poor in England, and their armies are maintained at less expence. It is computed by Mr Hume, that a British army of 20,000 men is maintained at near as great an expence as 60,000 in France, and that the English fleet, in the war of 1741, required as much money to support it as all the Roman legions in the time of the emperors. However, all that we can conclude from this is, that money is much more plentiful in Europe at present than it was in the Roman empire.

In the 13th century, the common interest which the Jews had for their money, Voltaire says, was 20 per cent. But with regard to this, we must consider the great contempt that nation was always held in, the large contributions they were frequently obliged to pay, the risk they ran of never receiving the principal, the frequent confiscations of all their effects, and the violent persecutions to which they were exposed; in which circumstances it was impossible for them to lend money at all, unless for most extravagant interest, and much disproportioned to its real value. Before the discovery of America, and the plantation of our colonies, the interest of money was generally 12 per cent. all over Europe; and it has been growing gradually less since that time, till it is now generally about four or five.

When sums of money are said to be raised by a whole people, in order to form a just estimate of it, we must take into consideration not only the quantity of the precious metal according to the standard of the coin, and the proportion of the quantity of coin to the commodities, but also the number and riches of the people who raise it; for populous and rich countries will much more easily raise any certain sum of money than one that is thinly inhabited, and chiefly by poor people. This circumstance greatly adds to our surprise at the vast sums of money raised by William the Conqueror, who had a revenue nearly in value equal to 12,000,000l. of our money (allowance being made for the standard of coin and the proportion it bore to the commodities), from a country not near so populous or rich as England is at present. Indeed, the accounts historians give us of the revenues of this prince, and the treasure he left behind him, are barely credible. Money.

II. *Imaginary Money*, or *Money of Account*, is that which has never existed, or at least which does not exist in real specie, but is a denomination invented or retained to facilitate the stating of accounts, by keeping them still on a fixed footing, not to be changed, like current coins, which the authority of the sovereign raises or lowers according to the exigencies of the state. Of which kind are pounds, livres, marks, maravedies, &c. See the annexed Table, where the fictitious money is distinguished by a dagger (†).

Moneys of Account among the Ancients.—The Grecians reckoned their sums of money by *drachma*, *minæ*, and *talenta*. The drachma was equal to 7¾d. sterling; 100 drachmæ made the mina, equal to 3l. 4s. 7d. sterling; 60 minæ made the talent, equal to 193l. 15s. sterling; hence 100 talents amounted to 19,375l. sterling. The mina and talentum, indeed, were different in different provinces: their proportions in Attic drachms are as follow: The Syrian mina contained 25 Attic drachms; the Ptolemaic 33⅓; the Antiochic and Eubœan 100; the Babylonic 116; the greater Attic and Tyrian 133⅓; the Æginean and Rhodian 166⅔. The Syrian talent contained 15 Attic minæ; the Ptolemaic 20; the Antiochic 60; the Eubœan 60; the Babylonic 70; the greater Attic and Tyrian 80; the Æginean and Rhodian 100.

2. Roman moneys of account were the *sestertius* and *sestertium*. The sestertius was equal to 1d. 3¼q. sterling. One thousand of these made the sestertium, equal to 8l. 1s. 5d. 2q. sterling. One thousand of these sestertia made the decies sestertium (the adverb *centies* being always understood) equal to 8072l. 18s. 4d. sterling. The decies sestertium they also called *decies centena millia nummum*. Centies sestertium, or centies HS, were equal to 80,729l. 3s. 4d. Millies HS to 807,291l. 13s. 4d. Millies centies HS to 888,020l. 16s. 8d.

Theory of Money.

1. *Of Artificial or Material Money.*

I. As far back as our accounts of the transactions of mankind reach, we find they had adopted the precious metals, that is, silver and gold, as the common measure of value, and as the adequate equivalent for every thing alienable.

The metals are admirably adapted for this purpose: they are perfectly homogeneous: when pure, their masses, or bulks, are exactly in proportion to their weights; no physical difference can be found between two pounds of gold, or silver, let them be the production of the mines of Europe, Asia, Africa, or America: they are perfectly malleable, fusible, and suffer

Money. the most exact division which human art is capable to give them: they are capable of being mixed with one another, as well as with metals of a baser, that is, of a less homogeneous nature, such as copper: by this mixture they spread themselves uniformly through the whole mass of the composed lump, so that every atom of it becomes proportionally possessed of a share of this noble mixture; by which means the subdivision of the precious metals is rendered very extensive.

Their physical qualities are invariable: they lose nothing by keeping; they are solid and durable; and though their parts are separated by friction, like every other thing, yet still they are of the number of those which suffer least by it.

If money, therefore, can be made of any thing, that is, if the proportional value of things vendible can be measured by any thing material, it may be measured by the metals.

II. The two metals being pitched upon as the most proper substances for realizing the ideal scale of money, those who undertake the operation of adjusting a standard, must constantly keep in their eye the nature and qualities of a scale, as well as the principles upon which it is formed.

The unit of the scale must constantly be the same, although realized in the metals, or the whole operation fails in the most essential part. This realizing the unit is like adjusting a pair of compasses to a geometrical scale, where the smallest deviation from the exact opening once given must occasion an incorrect measure. The metals, therefore, are to money what a pair of compasses is to a geometrical scale.

This operation of adjusting the metals to the money of account implies an exact and determinate proportion of both metals to the money unit, realized in all the species and denominations of coin, adjusted to that standard.

The smallest particle of either metal added to, or taken away from, any coins, which represent certain determinate parts of the scale, overturns the whole system of material money. And if, notwithstanding such variation, these coins continue to bear the same denominations as before, this will as effectually destroy their usefulness in measuring the value of things, as it would overturn the usefulness of a pair of compasses, to suffer the opening to vary, after it is adjusted to the scale representing feet, toises, miles, or leagues, by which the distances upon the plan are to be measured.

III. Debasing the standard is a good term, because it conveys a clear and distinct idea. It is diminishing the weight of the pure metal contained in that denomination by which a nation reckons, and which we have called the *money unit*. Raising the standard requires no farther definition, being the direct contrary.

IV. Altering the standard (that is, raising or debasing the value of the money unit) is like altering the national measures or weights. This is best discovered by comparing the thing altered with things of the same nature which have suffered no alteration. Thus, if the foot of measure was altered at once over all England, by adding to it, or taking from it, any proportional part of its standard length, the alteration would be best discovered by comparing the new foot with that of Paris, or of any other country, which had suffered no alteration. Just so, if the pound sterling, which is the English unit, shall be found anyhow changed, and if the variation it has met with be difficult to ascertain because of a complication of circumstances, the best way to discover it, will be to compare the former and the present value of it with the money of other nations which has suffered no variation. This the course of exchange will perform with the greatest exactness. Money.

V. Artists pretend, that the precious metals, when absolutely pure from any mixture, are not of sufficient hardness to constitute a solid and lasting coin. They are found also in the mines mixed with other metals of a baser nature; and the bringing them to a state of perfect purity occasions an unnecessary expence. To avoid, therefore, the inconvenience of employing them in all their purity, people have adopted the expedient of mixing them with a determinate proportion of other metals, which hurts neither their fusibility, malleability, beauty, nor lustre. This metal is called *alloy*: and, being considered only as a support to the principal metal, is accounted of no value in itself. So that eleven ounces of gold, when mixed with one ounce of silver, acquires by that addition no augmentation of value whatever.

This being the case, we shall, as much as possible, overlook the existence of alloy, in speaking of money, in order to render language less subject to ambiguity.

2. *Incapacities of the metals to perform the office of an invariable Measure of Value.*

I. Were there but one species of such a substance as we have represented gold and silver to be; were there but one metal possessing the qualities of purity, divisibility, and durability; the inconveniences in the use of it for money would be fewer by far than they are found to be as matters stand.

Such a metal might then, by an unlimited division into parts exactly equal, be made to serve as a tolerably steady and universal measure. But the rivalship between the metals, and the perfect equality which is found between all their physical qualities, so far as regards purity and divisibility, render them so equally well adapted to serve as the common measure of value, that they are universally admitted to pass current as money.

What is the consequence of this? that the one measures the value of the other, as well as that of every other thing. Now the moment any measure begins to be measured by another, whose proportion to it is not physically, perpetually, and invariably the same, all the usefulness of such a measure is lost. An example will make this plain.

A foot of measure is a determinate length. An English foot may be compared with the Paris foot, or with that of the Rhine; that is to say, it may be measured by them: and the proportion between their lengths may be expressed in numbers, which proportion will be the same perpetually. The measuring the one by the other will occasion no uncertainty; and we may speak of length by Paris feet, and

Money. be perfectly well understood by others who are used to measure by the English foot, or by the foot of the Rhine.

But suppose that a youth of 12 years old takes it into his head to measure from time to time, as he advanees in age, by the length of his own foot, and that he divides this growing foot into inches and deeimals: what ean be learned from his aeeount of measures? As he increases in years, his foot, inches, and subdivisions, will be gradually lengthening; and were every man to follow his example, and measure by his own foot, then the foot of a measure now established would totally cease to be of any utility.

This is just the ease with the two metals. There is no determinate invariable proportion between their value; and the consequenee of this is, that when they are both taken for measuring the value of other things, the things to be measured, like lengths to be measured by the young man's foot, without changing their relative proportion between themselves, change, however, with respect to the denominations of both their measures. An example will make this plain.

Let us suppose an ox to be worth 3000 pounds weight of wheat, and the one and the other to be worth an ounee of gold, and an ounce of gold to be worth exactly 15 ounees of silver: if the ease should happen, that the proportional value between gold and silver should eome to be as 14 is to 1, would not the ox, and consequently the wheat, be estimated at less in silver, and more in gold, than formerly? Farther, Would it be in the power of any state to prevent this variation in the measure of the value of oxen and wheat, without putting into the unit of their money less silver and more gold than formerly?

If therefore any partieular state should fix the standard of the unit of their money to one species of the metals, while in faet both the one and the other are aetually employed in measuring value; does not sueh a state resemble the young man who measures all by his growing foot? For if silver, for example, be retained as the standard, while it is gaining upon gold one-fifteenth additional valuc: and if gold eontinue all the while to determine the value of things as well as silver; it is plain, that, to all intents and purposes, this silver measure is lengthening daily like the young man's foot, since the same weight of it must become every day equivalent to more and more of the same eommodity; notwithstanding that we suppose the same proportion to subsist, without the least variation, between that commodity and every other speeies of things alienable.

Buying and selling are purely conventional, and no man is obliged to give his merchandise at what may be supposed to be the proportion of its worth. The use, therefore, of an universal measure, is to mark, not only the relative value of the things to whieh it is applied as a measure, but to diseover in an instant the proportion between the value of those, and of every other commodity valued by a determinate measure in all the countries of the world.

Were pounds sterling, livres, florins, piastres, &c. which are all money of account, invariable in their values, what a facility would it produce in all conversions! what an assistanee to trade! But as they are all limited or fixed to coins, and consequently vary from time to time, this example shows the utility of the invariable measure which we have described. Money.

There is another circumstanee whieh ineapaeitates the metals from performing the office of money; the substanee of whieh the coin is made, is a commodity which rises and sinks in its value with respeet to other eommodities, aeeording to the wants, competition, and capriees of mankind. The advantage, therefore, found in putting an intrinsie value into that substance which performs the funetion of money of account, is compensated by the instability of that intrinsic value; and the advantage obtained by the stability of paper, or symboliea money, is eompensated by the defect it commonly has of not being at all times suseeptible of realization into solid property or intrinsic value.

In order, therefore, to render material money more perfeet, this quality of metal, that is, of a eommodity, should be taken from it; and in order to render paper money more perfect, it ought to be made to circulate upon metallie or land sceurity.

II. There are several smaller ineonveniences accompanying the use of the metals, which we shall here shortly enumerate.

1*mo*, No money made of gold or silver can eireulate long, without losing its weight, although it all along preserves the same denomination. This represents the contraeting a pair of eompasses which had been rightly adjusted to the scale.

2*do*, Another ineonvenience proceeds from the fabrieation of money. Supposing the faith of prinees who eoin money to be inviolable, and the probity as well as capacity of those to whom they commit the inspeetion of the business of the metals to he suffieient, it is hardly possible for workmen to render every pieee exactly of a proper weight, or to preserve the due proportion between pieees of different denominations, that is to say, to make every ten sixpences exaetly of the same weight with every erown piece and every five shillings struek in a eoinage. In proportion to sueh inaeeuraeies, the parts of the seale beeome unequal.

3*tio*, Another ineonvenienee, and far from being ineonsiderable, flows from the expenee requisite for the eoining of money. This expence adds to its value as a manufaeture, without adding any thing to its weight.

4*to*, The last ineonvenienee is, that by fixing the money of aecount entirely to the coin, without having any independent common measure, (to mark and controul these deviations from mathematical exactness, which are either inseparable from the metals themselves, or from the fabrication of them), the whole measure of value, and all the relative interests of debtors and ereditors, beeome at the disposal not only of workmen in the mint, of Jews who deal in money, of clippers and washers in coin; but they are also entirely at the mercy of princes who have the right of eoinage, and who have frequently also the right of raising or debasing the standard of the coin, aeeording as they find it most for their present and temporary interest.

3. *Methods which may be proposed for lessening the several Inconveniences to which Material Money is liable.*

The inconveniences from the variation in the relative

Money. value of the metals to one another, may in some measure be obviated by the following expedients.

1*mo*, By considering one only as the standard, and leaving the other to seek its own value like any other commodity.

2*do*, By considering one only as the standard, and fixing the value of the other from time to time by authority, according as the market price of the metals shall vary.

3*tio*, By fixing the standard of the unit according to the mean proportion of the metals, attaching it to neither; regulating the coin accordingly; and upon every considerable variation in the proportion between them, either to make a new coinage, or to raise the denomination of one of the species, and lower it in the other in order to preserve the unit exactly in the mean proportion between the gold and silver.

4*to*, To have two units and two standards, one of gold and one of silver, and to allow every body to stipulate in either.

5*to*, Or last of all, To oblige all debtors to pay one half in gold, and one half in the silver standard.

4. *Variations to which the Value of the Money unit is exposed from every Disorder in the Coin.*

Let us suppose, at present, the only disorder to consist in a want of the due proportion between the gold and silver in the coin.

This proportion can only be established by the market price of the metals; because an augmentation and rise in the demand for gold or silver has the effect of augmenting the value of the metal demanded. Let us suppose, that to-day one pound of gold may buy fifteen pounds of silver: if to-morrow there be a high demand for silver, a competition among merchants to have silver for gold will ensue: they will contend who shall get the silver at the rate of 15 pounds for one of gold: this will raise the price of it; and in proportion to their views of profit, some will accept of less than the 15 pounds. This is plainly a rise in the silver, more properly than a fall in the gold; because it is the competition for the silver which has occasioned the variation in the former proportion between the metals.

Let us now suppose, that a state, having with great exactness examined the proportion of the metals in the market, and having determined the precise quantity of each for realizing or representing the money unit, shall execute a most exact coinage of gold and silver coin. As long as that proportion continues unvaried in the market, no inconvenience can result from that quarter in making use of metals for money of account.

But let us suppose the proportion to change; that the silver, for example, shall rise in its value with regard to gold: will it not follow, from that moment, that the unit realized in the silver, will become of more value than the unit realized in the gold coin?

But as the law has ordered them to pass as equivalents for one another, and as debtors have always the option of paying in what legal coin they think fit, will they not all choose to pay in gold; and will not then the silver coin be melted down and exported, in order to be sold as bullion, above the value it bears when it circulates in coin? Will not this paying in gold also really diminish the value of the money unit, since upon this variation every thing must sell for more gold than before, as we have already observed. Money.

Consequently, merchandises, which have not varied in their relative value to any other thing but to gold and silver, must be measured by the mean proportion of the metals: and the application of any other measure to them is altering the standard. If they are measured by the gold, the standard is debased; if by silver, it is raised.

If, to prevent the inconvenience of melting down the silver, the state shall give up affixing the value of their unit to both species at once, and shall fix it to one, leaving the other to seek its price as any other commodity; in that case, no doubt, the melting down of the coin will be prevented: but will this ever restore the value of the money unit to its former standard? Would it, for example, in the foregoing supposition, raise the debased value of the money unit in the gold coin, if that species were declared to be the standard? It would, indeed, render silver coin purely a merchandise, and, by allowing it to seek its value, would certainly prevent it from being melted down as before; because the pieces would rise conventionally in their denomination; or an *agio*, as it is called, would be taken in payments made in silver; but the gold would not, on that account, rise in its value, or begin to purchase any more merchandise than before. Were therefore the standard fixed to the gold, would not this be an arbitrary and a violent revolution in the value of the money unit, and a debasement of the standard?

If, on the other hand, the state should fix the standard to the silver, which we suppose to have risen in its value, would that ever sink the advanced value which the silver coin had gained above the worth of the former standard unit? and would not this be a violent and an arbitrary revolution in the value of the money unit, and a raising of the standard?

The only expedient, therefore, is, in such a case, to fix the numerary unit to neither of the metals, but to contrive a way to make it fluctuate in a mean proportion between them; which is in effect the introduction of a pure ideal money of account.

The regulation of fixing the unit by the mean proportion, ought to take place at the instant the standard unit is fixed with exactness both to the gold and silver. If it be introduced long after the market proportion between the metals has deviated from the proportion established in the coin; and if the new regulation is made to have a retrospect, with regard to the acquitting of permanent contracts entered into while the value of the money unit had attached itself to the lowest currency in consequence of the principle above laid down: then the restoring the money unit to that standard where it ought to have remained (to wit, to the mean proportion) is an injury to all debtors, who have contracted since the time that the proportion of the metals began to vary.

This is clear from the former reasoning. The moment the market price of the metals differs from that in the coin, every one who has payments to make, pays in that species which is the highest rated in the coin; consequently, he who lends, lends in that species. If after the contract, therefore, the unit is carried

Money. ried up to the mean proportion, this must be a loss to him who had borrowed.

From this we may perceive, why there is less inconvenience from the varying of the proportion of the metals, where the standard is fixed to one of them, than when it is fixed to both. In the first case, it is at least uncertain whether the standard or the merchandise species is to rise; consequently, it is uncertain whether the debtors or the creditors are to gain by a variation. If the standard species should rise, the creditors will gain; if the merchandise species rises, the debtors will gain; but when the unit is attached to both species, then the creditors never can gain, let the metals vary as they will; if silver rises, then debtors will pay in gold; if gold rises, the debtors will pay in silver. But whether the unit be attached to one or to both species, the infallible consequence of a variation is, that one half of the difference is either gained or lost by debtors and creditors. The invariable unit is constantly the mean proportional between the two measures.

5. *How the Variations of the intrinsic value of the Unit of Money must affect all the domestic Interests of a Nation.*

If the changing the content of the bushel by which grain is measured, would affect the interest of those who are obliged to pay, or who are entitled to receive, a certain number of bushels of grain for the rent of lands; in the same manner must every variation in the value of the unit of account affect all persons who, in permanent contracts, are obliged to make payments, or who are obliged to receive sums of money stipulated in multiples or in fractions of that money unit.

Every variation, therefore, upon the intrinsic value of the money unit, has the effect of benefiting the class of creditors at the expence of debtors, or *vice versa*.

This consequence is deduced from an obvious principle. Money is more or less valuable in proportion as it can purchase more or less of every kind of merchandise. Now, without entering anew into the causes of the rise and fall of prices, it is agreed upon all hands, that whether an augmentation of the general mass of money in circulation has the effect of raising prices in general or not, any augmentation of the quantity of the metals appointed to be put into the money unit, must at least affect the value of that money unit, and make it purchase more of any commodity than before: that is to say, 113 grains of fine gold, the present weight of a pound sterling in gold, can buy 113 pounds of flour; were the pound sterling raised to 114 grains of the same metal, it would buy 114 pounds of flour; consequently, were the pound sterling augmented by one grain of gold, every miller who paid a rent of ten pounds a-year, would be obliged to sell 1140 pounds of his flour, in order to procure ten pounds to pay his rent, in place of 1130 pounds of flour, which he sold formerly to procure the same sum; consequently, by this innovation, the miller must lose yearly ten pounds of flour, which his master consequently must gain. From this example, it is plain, that every augmentation of metals put into the pound sterling, either of silver or gold, must imply an advantage to the whole class of creditors who are paid in pounds sterling, and consequently must be a proportional loss to all debtors who must pay by the same denomination. Money.

6. *Of the Disorder in the British Coin, so far as it occasions the melting down or the exporting of the Specie.*

The defects in the British coin are three.

1*mo*, The proportion between the gold and silver in it is found to be as 1 to $15\frac{2}{10}$, whereas the market price may be supposed to be nearly as 1 to $14\frac{1}{2}$.

2*do*, Great part of the current money is worn and light.

3*tio*, From the second defect proceeds the third, to wit, that there are several currencies in circulation which pass for the same value, without being of the same weight.

4*to*, From all these defects results the last and greatest inconvenience, to wit, that some innovation must be made, in order to set matters on a right footing.

The English, besides the unit of their money which they call the pound sterling, have also the unit of their weight for weighing the precious metals.

This is called the *pound troy*, and consists of 12 ounces, every ounce of 20 pennyweights, and every pennyweight of 24 grains. The pound troy, therefore, consists of 240 pennyweights and 5760 grains.

The fineness of the silver is reckoned by the number of ounces and pennyweights of the pure metal in the pound troy of the composed mass; or, in other words, the pound troy, which contains 5760 grains of standard silver, contains 5328 grains of fine silver, and 432 grains of copper, called *alloy*.

Thus standard silver is 11 ounces 2 pennyweights of fine silver in the pound troy to 18 pennyweights copper, or 111 parts fine silver to nine parts alloy.

Standard gold is 11 ounces fine to 1 ounce silver or copper employed for alloy, which together make the pound troy; consequently, the pound troy of standard gold contains 5280 grains fine, and 480 grains alloy, which alloy is reckoned of no value.

This pound of standard silver is ordered, by statute of the 43d of Elizabeth, to be coined into 62 shillings, 20 of which make the pound sterling; consequently, the 20 shillings contain 1718.7 grains of fine silver, and 1858.06 standard silver.

The pound troy of standard gold, $\frac{11}{12}$ fine, is ordered, by an act of King Charles II. to be cut into $44\frac{1}{2}$ guineas: that is to say, every guinea contains 129.43 grains of standard gold, and 118.644 of fine gold; and the pound sterling, which is $\frac{20}{21}$ of the guinea, contains 112.994, which we may state at 113 grains of fine gold.

The coinage in England is entirely defrayed at the expence of the state. The mint price for the metals is the very same with the price of the coin. Whoever carries to the mint an ounce of standard silver, receives for it in silver coin 5s. 2d. or 62d.: whoever carries an ounce of standard gold receives in gold coin 3l. 17s. $10\frac{1}{2}$d. the one and the other making exactly an ounce of the same fineness with the bullion. Coin, therefore, can have

Money. have no value in the market above bullion; consequently, no loss can be incurred by those who melt it down.

When the guinea was first struck, the government (not inclining to fix the pound sterling to the gold coin of the nation) fixed the guinea at 20 shillings, (which was then below its proportion to the silver), leaving it to seek its own price above that value, according to the course of the market.

By this regulation no harm was done to the English silver standard; because the guinea, or 118.644 grains fine gold, being worth more, at that time, than 20 shillings, or 1718.7 grains fine silver, no debtor would pay with gold at its standard value; and whatever it was received for above that price was purely conventional.

Accordingly guineas sought their own price until the year 1728, that they were fixed a-new, not below their value as at first, but at what was then reckoned their exact value, according to the proportion of the metals, viz. at 21 shillings; and at this they were ordered to pass current in all payments.

This operation had the effect of making the gold a standard as well as the silver. Debtors then paid indifferently in gold as well as in silver, because both were supposed to be of the same intrinsic as well as current value; in which case no inconvenience could follow upon this regulation. But in time silver came to be more demanded; the making of plate began to prevail more than formerly, and the exportation of silver to the East Indies increasing yearly, made the demand for it greater, or perhaps brought its quantity to be proportionally less than before. This changed the proportion of the metals; and by slow degrees they have come from that of 1 to 15.2 (the proportion they were supposed to have when the guineas were fixed and made a lawful money at 21 shillings) to that of 14.5, the present *supposed* proportion.

The consequence of this has been, that the same guinea which was worth 1804.6 grains fine silver, at the time it was fixed at 21s. is now worth no more than 1719.9 grains of fine silver according to the proportion of $14\frac{1}{2}$ to 1.

Consequently debtors, who have always the option of the legal species in paying their debts, will pay pounds sterling no more in silver but in gold; and as the gold pounds they pay in are not intrinsically worth the silver pounds they paid in formerly according to the statute of Elizabeth, it follows that the pound sterling in silver is really no more the standard, since nobody will pay at that rate, and since nobody can be compelled to do it.

Besides this want of proportion between the metals, the silver coined before the reign of George I. is now become light by circulation; and the guineas coined by all the princes since Charles II. pass by tale, though many of them are considerably diminished in their weight.

Let us now examine what profit the want of proportion and the want of weight in the coin can afford to the money-jobbers in melting it down or exporting it.

Did every body consider coin only as the measure for reckoning value, without attending to its value as a metal, the deviations of gold and silver coin from perfect exactness, either as to proportion or weight, would occasion little inconvenience. Money.

Great numbers, indeed, in every modern society, consider coin in no other light than that of money of account; and have great difficulty to comprehend what difference any one can find between a light shilling and a heavy one, or what inconvenience there can possibly result from a guinea's being some grains of fine gold too light to be worth 21 shillings standard weight. And did every one think in the same way, there would be no occasion for coin of the precious metals at all; leather, copper, iron, or paper, would keep the reckoning as well as gold and silver.

But although there be many who look no farther than at the stamp on the coin, there are others whose sole business it is to examine its intrinsic worth as a commodity, and to profit of every irregularity in the weight and proportion of metals.

By the very institution of coinage, it is implied, that every piece of the same metal, and same denomination with regard to the money-unit, shall pass current for the same value.

It is, therefore, the employment of money-jobbers, to examine, with a scrupulous exactness, the precise weight of every piece of coin which comes into their hands.

The first object of their attention is, the price of the metals in the market: a jobber finds, at present, that with 14.5 pounds of fine silver bullion, he can buy one pound of fine gold bullion.

He therefore buys up with gold coin all the new silver as fast as it is coined, of which he can get at the rate of 15.2 pounds for one in gold; these 15.2 pounds silver coin he melts down into bullion, and converts that back into gold bullion, giving at the rate of only 14.5 pounds for one.

By this operation he remains with the value of $\frac{7}{10}$ of one pound weight of silver bullion clear profit upon the $15\frac{1}{2}$ pounds he bought; which is $\frac{7}{10}$ is really lost by the man who inadvertently coined silver at the mint, and gave it to the money-jobber for his gold. Thus the state loses the expence of the coinage, and the public the convenience of change for their guineas.

But here it may be asked, Why should the money-jobber melt down the silver coin? can he not buy gold with it as well without melting it down? He cannot; because when it is in coin he cannot avail himself of its being new and weighty. Coin goes by tale, not by weight; therefore, were he to come to market with his new silver coin, gold bullion being sold at the mint price, we shall suppose, viz. at 3l. 17s. $10\frac{1}{2}$d. sterling money per ounce, he would be obliged to pay the price of what he bought with heavy money, which he can do with light.

He therefore melts down the new silver coin, and sells it for bullion, at so many pence an ounce; the price of which bullion is, in the English market, always above the price of silver at the mint, for the reasons now to be given.

When you sell standard silver bullion at the mint, you are to be paid in weighty money; that is, you receive for your bullion the very same weight in standard coin; the coinage costs nothing: but when you sell bullion in the market you are paid in worn-out silver,

Money. silver, in gold, in bank notes, in short, in every species of lawful current money. Now all these payments have some defect: the silver you are paid with is worn and light; the gold you are paid with is overrated, and perhaps also light; and the bank notes must have the same value with the specie with which the bank pays them; that is, with light silver or overrated gold.

It is for these reasons, that silver bullion, which is bought by the mint at 5s. 2d. per ounce of heavy silver money, may be bought at market at 65 pence the ounce in light silver, overrated gold, or bank notes, which is the same thing.

Further, We have seen how the imposition of coinage has the effect of raising coin above the value of bullion, by adding a value to it which it had not as a metal.

Just so, when the unit is once affixed to certain determined quantities of both metals, if one of the metals should afterwards rise in value in the market, the coin made of that metal must lose a part of its value as coin, although it retains it as a metal. Consequently, as in the first case it acquired an additional value by being coined, it must now acquire an additional value by being melted down. From this we may conclude that when the standard is affixed to both the metals in the coin, and when the proportion of that value is not made to follow the price of the market, that species which rises in the market is melted down, and the bullion is sold for a price as much exceeding the mint price as the metal has risen in its value.

If, therefore, in England, the price of silver bullion is found to be at 65 pence the ounce, while at the mint it is rated at 62; this proves that silver has risen $\frac{1}{63}$ above the proportion observed in the coin, and that all coin of standard weight may consequently be melted down with a profit of $\frac{1}{63}$. But as there are several other circumstances to be attended to which regulate and influence the price of bullion, we shall here pass them in review, the better to discover the nature of this disorder in the English coin, and the advantages which money-jobbers may draw from it.

The price of bullion, like that of every other merchandise, is regulated by the value of the money it is paid with.

If bullion, therefore, sells in England for 65 pence an ounce paid in silver coin, it must sell for 65 shillings the pound troy; that is to say, the shillings it is commonly paid with do not exceed the weight of $\frac{1}{63}$ of a pound troy; for if the 65 shillings with which the pound of bullion is paid weigh more than a pound troy, it will be a shorter and better way for him who wants bullion to melt down the shillings and make use of the metal, than to go to market with them in order to get less.

We may, therefore, be very certain, that no man will buy silver bullion at 65 pence an ounce, with any shilling which weighs above $\frac{1}{63}$ of a pound troy.

We have gone upon the supposition that the ordinary price of bullion in the English market is 65 pence per ounce. This has been done upon the authority of some late writers on this subject: it is now proper to point out the causes which may make it deviate from that value.

I. It may, and certainly will vary, in the price, according as the currency is better or worse. When the expence of a war, or a wrong balance of trade, have carried off a great many heavy guineas, it is natural that bullion should rise; because then it will be paid for more commonly in light gold and silver; that is to say, with pounds sterling, below the value of 113 grains fine gold, the worth of the pound sterling in new guineas. Money.

II. This wrong balance of trade, or a demand for bullion abroad, becoming very great, may occasion a scarcity of the metals in the market, as well as a scarcity of the coin; consequently, an advanced price must be given for it in proportion to the greatness and height of the demand. In this case, both the specie and the bullion must be bought with paper. But the rise in the price of bullion proceeds from the demand for the metals and the competition between merchants to procure them, and not because the paper given as the price is at all of inferior value to the specie. The least discredit of this kind would not tend to diminish the value of the paper; it would annihilate it at once. Therefore, since the metals must be had, and that the paper cannot supply the want of them when they are to be exported, the price rises in proportion to the difficulties in finding metals elsewhere than in the English market.

III. A sudden call for bullion, for the making of plate. A goldsmith can well afford to give 67 pence for an ounce of silver, that is to say, he can afford to give one pound of gold for 14 pounds of silver, and perhaps for less, notwithstanding that what he gives be more than the ordinary proportion between the metals, because he indemnifies himself amply by the price of his workmanship; just as a tavern keeper will pay any price for a fine fish, because, like the goldsmith, he buys for other people.

IV. The mint price has as great an effect in bringing down the price of bullion, as exchange has in raising it. In countries where the metals in the coin are justly proportioned, where all the currencies are of legal weight, and where coinage is imposed, the operations of trade make the price of bullion constantly to fluctuate between the value of the coin and the mint price of the metals.

Now let us suppose that the current price of silver bullion in the market is 65 pence the ounce, paid in lawful money, no matter of what weight or of what metal. Upon this the money-jobber falls to work. All shillings which are above $\frac{1}{63}$ of a pound troy, he throws into his melting pot, and sells them as bullion for 65d. per ounce; all those which are below that weight he carries to market, and buys bullion with them at 65d. per ounce.

What is the consequence of this?

That those who sell the bullion, finding the shillings which the money-jobber pays with perhaps not above $\frac{1}{66}$ of a pound troy, they on their side raise the price of the bullion to 66d. the ounce.

This makes new work for the money-jobber; for he must always gain. He now weighs all shillings as they come to hand; and as formerly he threw into his melting pot those only which were worth more than $\frac{1}{63}$ of a pound troy, he now throws in all that are in va-

lue

Money. lue above $\frac{1}{66}$. He then sells the melted shillings at 66d. the ounce, and buys bullion with the light ones at the same price.

This is the consequence of ever permitting any species of coin to pass by the authority of the stamp, without controlling it at the same time by the weight: and this is the manner in which money-jobbers gain by the currency of light money.

It is no argument against this exposition of the matter to say, that silver bullion is seldom bought with silver coin; because the pence in new guineas are worth no more than the pence of shillings of 65 in the pound troy: that is to say, that 240 pence contained in $\frac{20}{21}$ of a new guinea, and 240 pence contained in 28 shillings of 65 to the pound troy, differ no more in the intrinsic value than 0.83 of a grain of fine silver upon the whole, which is a mere trifle.

Whenever, therefore, shillings come below the weight of $\frac{1}{65}$ of a pound troy, then there is an advantage in changing them for new guineas; and when that is the case, the new guineas will be melted down, and profit will be found in selling them for bullion, upon the principles we have just been explaining.

We have already given a specimen of the domestic operations of the money-jobbers; but these are not the most prejudicial to national concerns. The jobbers may be supposed to be Englishmen; and in that case the profit they make remains at home: but whenever there is a call for bullion to pay the balance of trade, it is evident that this will be paid in silver coin; never in gold, if heavy silver can be got; and this again carries away the silver coin, and renders it at home so rare, that great inconveniences are found for want of the lesser denominations of it. The loss, however, here is confined to an inconvenience; because the balance of trade being a debt which must be paid, we do not consider the exportation of the silver for that purpose as any consequence of the disorder of the coin. But besides this exportation which is necessary, there are others which are arbitrary, and which are made only with a view to profit of the wrong proportion.

When the money-jobbers find difficulty in carrying on the traffic we have described, in the English market, because of the competition among themselves, they carry the silver coin of the country, and sell it abroad for gold, upon the same principles that the East India Company send silver to China in order to purchase gold.

It may be demanded, What hurt this trade can do to Britain, since those who export silver bring back the same value in gold? Were this trade carried on by natives, there would be no loss; because they would bring home gold for the whole intrinsic value of the silver. But if we suppose foreigners sending over gold to be coined at the English mint, and changing the gold into English silver coin, and then carrying off this coin, it is plain that they must gain the difference, as well as the money-jobbers. But it may be answered, That having given gold for silver at the rate of the mint, they have given value for what they have received. Very right; but so did Sir Hans Sloane, when he paid five guineas for an overgrown toad: he got value for his money; but it was value only to himself. Just so, whenever the English government shall be obliged to restore the proportion of the metals (as they must do), this operation will annihilate that imaginary value which they have hitherto set upon gold; which imagination is the only thing which renders the exchange of their silver against the foreign gold equal. Money.

But it is farther objected, that foreigners cannot carry off the heavy silver; because there is none to cary off. Very true; but then they have carried off a great quantity already: or if the English Jews have been too sharp to allow such a profit to fall to strangers, (which may or may not have been the case), then this disorder is an effectual stop to any more coinage of silver for circulation.

7. *Of the Disorder in the British Coin, so far as it affects the Value of the Pound Sterling Currency.*

From what has been said, it is evident, that there must be found in England two legal pounds sterling, of different values; the one worth 113 grains of fine gold, the other worth 1718.7 grains of fine silver. We call them different: because these two portions of the precious metals are of different values all over Europe.

But besides these two different pounds sterling, which the change in the proportion of the metals has created, the other defects of the circulating coin produce similar effects. The guineas coined by all the princes since King Charles II. have been of the same standard weight and fineness, 44½ in a pound troy of standard gold $\frac{11}{12}$ fine: these have been constantly wearing ever since they have been coined; and in proportion to their wearing they are of less value.

If, therefore, the new guineas are below the value of a pound sterling in silver, standard weight, the old must be of less value still. Here then is another currency, that is, another pound sterling; or indeed, more properly speaking, there are as many different pounds sterling as there are guineas of different weights. This is not all; the money-jobbers having carried off all the weighty silver, that which is worn with use, and reduced even below the standard of gold, forms one currency more, and totally destroys all determinate proportion between the money unit and the currencies which are supposed to represent it.

It may be asked, how, at this rate, any silver has remained in England? It is answered, that the few weighty shillings which still remain in circulation, have marvellously escaped the hands of the money-jobbers: and as to the rest, the rubbing and wearing of these pieces has done what the state might have done; that is to say, it has reduced them to their due proportion with the lightest gold.

The disorder, therefore, of the English coin has rendered the standard of a pound sterling quite uncertain. To say that it is 1718.7 grains of fine silver, is quite ideal. Who are paid in such pounds? To say that it is 113 grains of pure gold, may also not be true; because there are many currencies worse than the new guineas.

What then is the consequence of all this disorder? What effect has it upon the current value of a pound sterling? And which way can the value of that be determined?

The operations of trade bring value to an equation, notwithstanding the greatest irregularities possible; and

Money. value over all the world by the means of foreign exchange. This is a kind of ideal scale for measuring the British coin, although it has not all the properties of that described above.

Exchange considers the pound sterling as a value determined according to the combination of the values of all the different currencies, in proportion as payments are made in the one or the other; and as debtors generally take care to pay in the worst species they can, it consequently follows, that the value of the pound sterling should fall to that of the lowest currency.

Were there a sufficient quantity of worn gold and silver to acquit all bills of exchange, the pound sterling would come down to the value of them; but if the new gold be also necessary for that purpose, the value of it must be proportionably greater.

All these combinations are liquidated and compensated with one another, by the operations of trade and exchange; and the pound sterling, which is so different in itself, becomes thereby, in the eyes of commerce, a determinate unit; subject, however to variations, from which it never can be exempted.

Exchange, therefore, is one of the best measures for valuing a pound sterling, present currency. Here occurs a question:

Does the great quantity of paper money in England tend to diminish the value of the pound sterling?

We answer in the negative. Paper money is just as good as gold or silver money, and no better. The variation of the standard, as we have already said, must influence the interest of debtors and creditors proportionally everywhere. From this it follows, that all augmentation of the value of the money unit in the specie must hurt the debtors in the paper money; and all diminutions, on the other hand, must hurt the creditors in the paper money as well as everywhere else. The payments, therefore, made in paper money, never can contribute to the regulation of the standard of the pound sterling; it is the specie received in liquidation of that paper money which alone can contribute to mark the value of the British unit; because it is affixed to nothing else.

From this we may draw a principle, "That in countries where the money unit is entirely affixed to the coin, the actual value of it is not according to the legal standard of that coin, but according to the mean proportion of the actual worth of those currencies in which debts are paid.

From this we see the reason why the exchange between England and all other trading towns in Europe has long appeared so unfavourable. People calculate the real par, upon the supposition that a pound sterling is worth 1718.7 grains troy of fine silver, when in fact the currency is not perhaps worth 1638, the value of a new guinea in silver, at the market proportion of 1 to 14.5; that is to say, the currency is but 95.3 per cent. of the silver standard of the 43d of Elizabeth. No wonder then if the exchange be thought unfavourable.

From the principle we have just laid down, we may gather a confirmation of what we advanced concerning the cause of the advanced price of bullion in the English market.

When people buy bullion with current money at a determinate price, that operation, in conjunction with the course of exchange, ought naturally to mark the actual value of the pound sterling with great exactness. Money.

If therefore the price of standard bullion in the English market, when no demand is found for the exportation of the metals, that is to say, when paper is found for paper upon exchange, and when merchants versed in these matters judge exchange (that is remittances) to be at par, if then silver bullion cannot be bought at a lower price than 65 pence the ounce, it is evident that this bullion might be bought with 65 pence in shillings, of which 65 might be coined out of the pound troy English standard silver; since 65 per ounce implies 65 shillings for the 12 ounces or pound troy.

This plainly shows how standard silver bullion should sell for 65 pence the ounce, in a country where the ounce of standard silver in the coin is worth no more than 62; and were the market price of bullion to stand uniformly at 65 pence per ounce, that would show the value of the pound sterling to be tolerably fixed. All the heavy silver coin is now carried off; because it was intrinsically worth more than the gold it passed for in currency. The silver therefore which remains is worn down to the market proportion of the metals, as has been said; that is to say, 20 shillings in silver currency are worth 113 grains of fine gold, at the proportion of 1 to 14.5 between gold and silver. Now,

as 1 is to 14.5, so is 113 to 1638:

so the 20 shillings current weigh but 1638 grains fine silver, instead of 1718.7, which they ought to do according to the standard.

Now let us speak of standard silver, since we are examining how far the English coin must be worn by use.

The pound troy contains 5760 grains. This, according to the standard, is coined into 62 shillings; consequently, every shilling ought to weigh 92.9 grains. Of such shillings it is impossible that ever standard bullion should sell at above 62 pence per ounce. If therefore such bullion sells for 65 pence, the shillings with which it is bought must weigh no more than 88.64 grains standard silver; that is, they must lose 4.29 grains, and are reduced to $\frac{1}{21}$ of a pound troy.

But it is not necessary that bullion be bought with shillings: no stipulation of price is ever made farther, than at so many pence sterling per ounce. Does not this virtually determine the value of such currency with regard to all the currencies in Europe? Did a Spaniard, a Frenchman, or a Dutchman, know the exact quantity of silver bullion which can be bought in the London market for a pound sterling, would he inform himself any farther as to the intrinsic value of that money unit? would he not understand the value of it far better from that circumstance than by the course of any exchange, since exchange does not mark the intrinsic value of money, but only the value of that money transported from one place to another?

The price of bullion, therefore, when it is not influenced by extraordinary demand, (such as for the payment of a balance of trade, or for making an extraordinary

Money. traordinary provision of plate), but when it stands at what every body knows to be meant by the common market price, is a very tolerable measure of the value of the actual money standard in any country.

If it be therefore true, that a pound sterling cannot purchase above 1638 grains of fine silver bullion, it will require not a little logic to prove that it is really, or has been for these many years, worth any more; notwithstanding that the standard weight of it in England is regulated by the laws of the kingdom at 1718.7 grains of fine silver.

If to this valuation of the pound sterling drawn from the price of bullion, we add the other drawn from the course of exchange; and by this we find that when paper is found for paper upon exchange, a pound sterling cannot purchase above 1638 grains of fine silver in any country in Europe: upon these two authorities we may very safely conclude (as to the matter of fact at least) that the pound sterling is not worth more, either in London or in any other trading city; and if this be the case, it is just worth 20 shillings of 65 to the pound troy.

If therefore the mint were to coin shillings at that rate, and pay for silver bullion at the market price, that is, at the rate of 65 pence per ounce in those new coined shillings, they would be in proportion to the gold; silver would be carried to the mint equally with gold, and would be as little subject to be exported or melted down.

It may be inquired in this place, how far the coining the pound troy into 65 shillings is contrary to the laws of England?

The moment a state pronounces a certain quantity of gold to be worth a certain quantity of silver, and orders these respective quantities of each metal to be received as equivalents of each other, and as lawful money in payments, that moment gold is made a standard as much as silver. If therefore too small a quantity of gold be ordered or permitted to be considered as an equivalent for the unit, the silver standard is from that moment debased; or indeed, more properly speaking, all silver money is from that moment proscribed; for who, from that time, will ever pay in silver, when he can pay cheaper in gold? Gold, therefore, by such a law, is made the standard, and all declarations to the contrary are against the matter of fact.

Were the king, therefore, to coin silver at 65 shillings in the pound, it is demonstration, that by such an act he would commit no adulteration upon the standard: the adulteration is already committed. The standard has descended to where it is by slow degrees, and by the operation of political causes only; and nothing prevents it from falling lower but the standard of the gold coin. Let guineas be now left to seek their value as they did formerly, and let light silver continue to go by tale, we shall see the guineas up at 30 shillings in 20 years time, as was the case in 1695.

It is as absurd to say that the standard of Queen Elizabeth has not been debased by enacting that the English unit shall be acquitted with 113 grains of fine gold, as it would be to affirm that it would not be debased from what it is at present by enacting that a pound of butter should everywhere be received in payment for a pound sterling; although the pound sterling should continue to consist of three ounces, 17 penny-weights, and 10 grains of standard silver, according to the statute of the 43d of Elizabeth. In that case, most debtors would pay in butter; and silver would, as at present, acquire a conventional value as a metal, but would be looked upon no longer as a standard, or as money. Money.

If therefore, by the law of England, a pound sterling must consist of 1718.7 grains troy of fine silver; by the law of England also, 113 grains of gold must be of the same value: but no law can establish that proportion; consequently, in which ever way a reformation be brought about, some law must be reversed; consequently, expediency, and not compliance with law, must be the motive in reforming the abuse.

From what has been said, it is not at all surprising that the pound sterling should in fact be reduced nearly to the value of the gold. Whether it ought to be kept at that value is another question. All that we here decide is, that coining the pound troy into 65 shillings would restore the proportion of the metals, and render both species common in circulation. But restoring the weight and proportion of the coin is not the difficulty which prevents a reformation of the English coinage.

8. *Circumstances to be attended to in a New Regulation of the British Coin.*

To people who do not understand the nature of such operations, it may have an air of justice to support the unit at what is commonly believed to be the standard of Queen Elizabeth, viz. at 1718.7 grains of fine silver.

The regulating the standard of both silver and gold to $\frac{11}{12}$ fine, and the pound sterling to four ounces standard silver, as it stood during the reign of Queen Mary I. has also its advantages, as Mr Harris has observed. It makes the crown-piece to weigh just one ounce, the shilling four pennyweights, and the penny eight grains: consequently, were the new statute to bear, that the weight of the coin should regulate its currency upon certain occasions, the having the pieces adjusted to certain aliquot parts of weight would make weighing easy, and would accustom the common people to judge of the value of money by its weight, and not by the stamp.

In that case, there might be a convenience in striking the gold coins of the same weight with the silver; because the proportion of their values would then constantly be the same with the proportion of the metals. The gold crowns would be worth at present, 3l. 12s. 6d. the half-crowns 1l. 16s. 3d. the gold shillings 14s. 6d. and the half 7s. 3d. This was anciently the practice in the Spanish mints.

The interests within the state can be nowise perfectly protected, but by permitting conversions of value from the old to the new standard, whatever it be, and by regulating the footing of such conversions by act of parliament, according to circumstances.

For this purpose, we shall examine those interests which will chiefly merit the attention of government, when they form a regulation for the future of acquitting

Money. ting permanent contracts already entered into. Such as may be contracted afterwards will naturally follow the new standard.

The landed interest is no doubt the most considerable in the nation. Let us therefore examine, in the first place, what regulations it may be proper to make, in order to do justice to this great class, with respect to the land tax on one hand, and with respect to their lessees on the other.

The valuation of the lands of England was made many years ago, and reasonably ought to be supported at the real value of the pound sterling at that time, according to the principles already laid down. The general valuation, therefore, of the whole kingdom will rise according to this scheme. This will be considered as an injustice; and no doubt it would be so, if for the future, the land tax be imposed as heretofore, without attending to this circumstance; but as that imposition is annual, as it is laid on by the landed interest itself, who compose the parliament, it is to be supposed that this great class will at least take care of their own interest.

Were the valuation of the lands to be stated according to the valuation of the pound sterling of 1718.7 grains of silver, which is commonly supposed to be the standard of Elizabeth, there would be no great injury done; this would raise the valuation only 5 per cent. and the land tax in proportion.

There is no class of inhabitants in all England so much at their ease, and so free from taxes, as the class of farmers. By living in the country, and by consuming the fruits of the earth without their suffering any alienation, they avoid the effect of many excises, which, by those who live in corporations, are felt upon many articles of their consumption, as well as on those which are immediately loaded with these impositions. For this reason it will not, perhaps, appear unreasonable, if the additional 5 per cent. on the land tax were thrown upon this class, and not upon the landlords.

With respect to leases, it may be observed, that we have gone upon the supposition that the pound sterling in the year 1728 was worth 1718.7 grains of fine silver, and 113 grains of fine gold.

There would be no injustice done the lessees of all the lands in the kingdom, were their rents to be fixed at the mean proportion of these values. We have observed how the pound sterling has been gradually diminishing in its worth from that time by the gradual rise of the silver. This mean proportion, therefore, will nearly answer to what the value of the pound sterling was in 1743; supposing the rise of the silver to have been uniform.

It may be farther alleged in favour of the landlords, that the gradual debasement of the standard has been more prejudicial to their interest in letting their lands, than to the farmers in disposing of the fruits of them. Proprietors cannot so easily raise their rents upon new leases, as farmers can raise the prices of their grain according to the debasement of the value of the currency.

The pound sterling, thus regulated at the mean proportion of its worth, as it stands at present, and as it stood in 1728, may be realized in 1678.6 grains of fine silver, and 115.76 grains fine gold; which is 2½ per cent. above the value of the present currency. No injury, therefore, would be done to lessees, and no unreasonable gain would accrue to the landed interest, in appointing conversions of all land rents at 2½ per cent. above the value of the present currency. Money.

Without a thorough knowledge of every circumstance relating to Great Britain, it is impossible to lay down any plan. It is sufficient here briefly to point out the principles upon which it must be regulated.

The next interest to be considered is that of the nation's creditors. The right regulation of their concerns will have a considerable influence in establishing public credit upon a solid basis, by making it appear to all the world, that no political operation upon the money of Great Britain can in any respect either benefit or prejudice the interest of those who lend their money upon the faith of the nation. The regulating also the interest of so great a body, will serve as a rule for all creditors who are in the same circumstances, and will upon other accounts be productive of greater advantages to the nation in time coming.

In 1749, a new regulation was made with the public creditors, when the interest of the whole redeemable national debt was reduced to 3 per cent. This circumstance infinitely facilitates the matter with respect to this class, since by this innovation of all former contracts, the whole national debt may be considered as contracted at, or posterior to, the 25th December 1749.

Were the state, by an arbitrary operation upon money (which every reformation must be), to diminish the value of the pound sterling in which the parliament at that time bound the nation to acquit those capitals and the interest upon them, would not all Europe say, That the British parliament had defrauded their creditors? If therefore the operation proposed to be performed should have a contrary tendency, viz. to augment the value of the pound sterling with which the parliament at that time bound the nation to acquit those capitals and interests, must not all Europe also agree, that the British parliament had defrauded the nation?

The convention with the ancient creditors of the state, who, in consequence of the debasement of the standard, might have justly claimed an indemnification for the loss upon their capitals, lent at a time when the pound sterling was at the value of the heavy silver, removes all causes of complaint from that quarter. There was in the year 1749 an innovation in all their contracts; and they are now to be considered as creditors only from the 25th of December of that year.

Let the value of the pound sterling be inquired into during one year preceding and one posterior to the transaction of the month of December 1749. The great sums borrowed and paid back by the nation during that period, will furnish data sufficient for that calculation. Let this value of the pound be specified in troy grains of fine silver and fine gold bullion, without mentioning any denomination of money according to the exact proportion of the metals at that time. And let this pound be called the *pound of national credit*.

This first operation being determined, let it be enacted, that the pound sterling, by which the state is to

Money. borrow for the future, and that in which the creditors are to be paid, shall be the exact mean proportion between the quantities of gold and silver above specified, according to the actual proportion of the metals at the time such payments shall be made: or that the sums shall be borrowed or acquitted, one half in gold and one half in silver, at the respective requisitions of the creditors or of the state, when borrowing. All debts contracted posterior to 1749 may be made liable to conversions.

The consequence of this regulation will be the insensible establishment of a bank money. Nothing would be more difficult to establish, by a positive revolution, than such an invariable measure; and nothing will be found so easy as to let it establish itself by its own advantages. This bank money will be liable to much fewer inconveniences than that of Amsterdam. There the persons transacting must be upon the spot; here, the sterling currency may, every quarter of a year, be adjusted by the exchequer to this invariable standard, for the benefit of all debtors and creditors who incline to profit of the stability of this measure of value.

This scheme is liable to no inconvenience from the variation of the metals, let them be ever so frequent or hard to be determined; because upon every occasion where there is the smallest doubt as to the actual proportion, the option competent to creditors to be paid half in silver and half in gold will remove.

Such a regulation will also have this good effect, that it will give the nation more just ideas of the nature of money, and consequently of the influence it ought to have upon prices.

If the value of the pound sterling shall be found to have been by accident less in December 1749 than it is at present; or if at present the currency be found below what it has commonly been since 1749; in justice to the creditors, and to prevent all complaints, the nation may grant them the mean proportion of the value of the pound sterling from 1749 to 1760, or any other which may to parliament appear reasonable.

This regulation must appear equitable in the eyes of all Europe; and the strongest proof of it will be, that it will not produce the smallest effect prejudicial to the interest of the foreign creditors. The course of exchange with regard to them will stand precisely as before.

A Dutch, French, or German creditor, will receive the same value for his interest in the English stocks as heretofore. This must silence all clamours at home, being the most convincing proof, that the new regulation of the coin will have made no alteration upon the real value of any man's property, let him be debtor or creditor.

The interest of every other denomination of creditors, whose contracts are of a fresh date, may be regulated upon the same principles. But where debts are of an old standing, justice demands, that attention be had to the value of money at the time of contracting. Nothing but the stability of the English coin, when compared with that of other nations, can make such a proposal appear extraordinary. Nothing is better known in France than this stipulation added to obligations, *Argent au cours de ce jour*; that is to say, That the sum shall be paid in coin of the same intrinsic value with what has been lent. Why should such a clause be thought reasonable for guarding people against arbitrary operations upon the numerary value of the coin, and not be found just upon every occasion where the numerary value of it is found to be changed, let the cause be what it will? Money.

The next interest we shall examine is that of trade. When men have attained the age of 21, they have no more occasion for guardians. This may be applied to traders; they can parry with their pen every inconvenience which may result to other people from the changes upon money, provided only the laws permit them to do themselves justice with respect to their engagements. This class demands no more than a right to convert all reciprocal obligations into denominations of coin of the same intrinsic value with those they have contracted in.

The next interest is that of buyers and sellers; that is, of manufacturers with regard to consumers, and of servants with respect to those who hire their personal service.

The interest of this class requires a most particular attention. They must, literally speaking, be put to school, and taught the first principles of their trade, which is buying and selling. They must learn to judge of price by the grains of silver and gold they receive: they are children of a mercantile mother, however warlike the father's disposition. If it be the interest of the state that their bodies be rendered robust and active, it is no less the interest of the state that their minds be instructed in the first principles of the trade they exercise.

For this purpose, tables of conversion from the old standard to the new must be made, and ordered to be put up in every market, in every shop. All duties, all excises, must be converted in the same manner. Uniformity must be made to appear everywhere. The smallest deviation from this will be a stumbling block to the multitude.

Not only the interest of the individuals of the class we are at present considering, demands the nation's care and attention in this particular; but the prosperity of trade, and the wellbeing of the nation, are also deeply interested in the execution,

The whole delicacy of the intricate combinations of commerce depends upon a just and equable vibration of prices, according as circumstances demand it. The more, therefore, the industrious classes are instructed in the principles which influence prices, the more easily will the machine move. A workman then learns to sink his price without regret, and can raise it without avidity. When principles are not understood, prices cannot gently fall, they must be pulled down: and merchants dare not suffer them to rise, for fear of abuse, even although the perfection of an infant manufacture should require it.

The last interest is that of the bank of England, which naturally must regulate that of every other.

Had this great company followed the example of other banks, and established a bank-money of an invariable standard as the measure of all their debts and credits, they would not have been liable to any inconvenience upon a variation of the standard.

The

Money. The bank of England was projected about the year 1694, at a time when the current money of the nation was in the greatest disorder, and government in the greatest distress both for money and for credit. Commerce was then at a very low ebb; and the only, or at least the most profitable, trade of any, was jobbing in coin, and carrying backwards and forwards the precious metals from Holland to England. Merchants profited also greatly from the effects which the utter disorder of the coin produced upon the price of merchandise.

At such a juncture the resolution was taken to make a new coinage; and upon the prospect of this, a company was found, who, for an exclusive charter to hold a bank for 13 years, willingly lent the government upwards of a million sterling at 8 per cent. (in light money we suppose), with a prospect of being repaid both interest and capital in heavy. This was not all: part of the money lent was to be applied for the establishment of the bank; and no less than 4000l. a-year was allowed to the company, above the full interest, for defraying the charge of the management.

Under such circumstances the introduction of bank-money was very superfluous, and would have been very impolitic. That invention is calculated against the raising of the standard: but here the bank profited of that rise in its quality of creditor for money lent; and took care not to commence debtor by circulating their paper until the effect of the new regulation took place in 1695; that is, after the general re-coinage of all the clipped silver.

From that time till now, the bank of England has been the basis of the nation's credit, and with great reason has been constantly under the most intimate protection of every minister.

The value of the pound sterling, as we have seen, has been declining ever since the year 1601, the standard being fixed to silver during all that century, while the gold was constantly rising. No sooner had the proportion taken another turn, and silver begun to rise, than the government of England threw the standard virtually upon the gold, by regulating the value of the guineas at the exact proportion of the market. By these operations, however, the bank has constantly been a gainer (in its quality of debtor) upon all the paper in circulation; and therefore has lost nothing by not having established a bank-money.

The interest of this great company being established upon the principles we have endeavoured to explain, it is very evident, that the government of England never will take any step in the reformation of the coin which in its consequences can prove hurtful to the bank. Such a step would be contrary both to justice and to common sense. To make a regulation which, by raising the standard, would prove beneficial to the public creditors, to the prejudice of the bank (which we may call the *public debtor*), would be an operation upon public credit like that of a person who is at great pains to support his house by props on all sides, and who at the same time blows up the foundation of it with gunpowder.

We may therefore conclude, that with regard to the bank of England, as well as every other private banker, the notes which are constantly payable upon demand must be made liable to a conversion at the actual value of the pound sterling at the time of the new regulation. Money.

That the bank will gain by this, is very certain; but the circulation of their notes is so swift, that it would be absurd to allow to the then possessors of them that indemnification which naturally should be shared by all those through whose hands they have passed, in proportion to the debasement of the standard during the time of their respective possession.

Besides these considerations, which are in common to all states, the government of Great Britain has one peculiar to itself. The interest of the bank, and that of the creditors, are diametrically opposite; every thing which raises the standard hurts the bank; every thing which can sink it hurts the creditors: and upon the right management of the one and the other, depends the solidity of public credit. For these reasons, without the most certain prospect of conducting a restitution of the standard to the general advantage as well as approbation of the nation, no minister will probably ever undertake so dangerous an operation.

We shall now propose an expedient which may remove at least some of the inconveniences which would result from so extensive an undertaking as that of regulating the respective interests in Great Britain by a positive law, upon a change in the value of their money of account.

Suppose then, that, before any change is made in the coin, government should enter into a transaction with the public creditors, and ascertain a permanent value for the pound sterling for the future, specified in a determined proportion of the fine metals in common bullion, without any regard to money of account, or to any coin whatever.

This preliminary step being taken, let the intended alteration of the standard be proclaimed a certain time before it is to commence. Let the nature of the change be clearly explained, and let all such as are engaged in contracts which are dissolvable at will upon the prestations stipulated, be acquitted between the parties, or innovated as they shall think proper; with certification, that, posterior to a certain day, the stipulations formerly entered into shall be binding according to the denominations of the money of account in the new standard.

As to permanent contracts, which cannot at once be fulfilled and dissolved, such as leases, the parliament may either prescribe the methods and terms of conversion; or a liberty may be given to the parties to annul the contract, upon the debtor's refusing to perform his agreement according to the new standard. Contracts, on the other hand, might remain stable, with respect to creditors who would be satisfied with payments made on the footing of the old standard. If the rise intended should not be very considerable, no great injustice can follow such a regulation.

Annuities are now thoroughly understood, and the value of them is brought to so nice a calculation, that nothing will be easier than to regulate these upon the footing of the value paid for them, or of the subject affected by them. If by the regulation, land rents are made to rise in denomination, the annuities charged upon them ought to rise in proportion; if in intrinsic value, the annuity should remain as it was.

9. *Regulations*

Money.

9. *Regulations which the Principles of this Inquiry point out as expedient to be made by a new Statute for regulating the British Coin.*

Let us now examine what regulations it may be proper to make by a new statute concerning the coin of Great Britain, in order to preserve always the same exact value of the pound sterling realized in gold and in silver, in spite of all the incapacities inherent in the metals to perform the functions of an invariable scale or measure of value.

1. The first point is to determine the exact number of grains of fine gold and fine silver which are to compose it, according to the then proportion of the metals in the London market.

2. To determine the proportion of these metals with the pound troy; and in regard that the standard of gold and silver is different, let the mint price of both metals be regulated according to the pound troy fine.

3. To fix the mint price within certain limits; that is to say, to leave to the king and council, by proclamation, to carry the mint price of bullion up to the value of the coin, as is the present regulation, or to sink it to per cent. below that price, according as government shall incline to impose a duty upon coinage.

4. To order, that silver and gold coin shall be struck of such denominations as the king shall think fit to appoint; in which the proportion of the metals above determined shall be constantly observed through every denomination of the coin, until necessity shall make a new general coinage unavoidable.

5. To have the number of grains of the fine metal in every piece marked upon the exergue, or upon the legend of the coin, in place of some initial letters of titles, which not one person in a thousand can decypher; and to make the coin of as compact a form as possible, diminishing the surface of it as much as is consistent with beauty.

6. That it shall be lawful for all contracting parties to stipulate their payments either in gold or silver coin, or to leave the option of the species to one of the parties.

7. That where no particular stipulation is made, creditors shall have power to demand payment, half in one species, half in the other; and when the sum cannot fall equally into gold and silver coins, the fractions to be paid in silver.

8. That in buying and selling, when no particular species has been stipulated, and when no act in writing has intervened, the option of the species shall be competent to the buyer.

9. That all sums paid or received by the king's receivers, or by bankers, shall be delivered by weight, if demanded.

10. That all money which shall be found under the legal weight, from whatever cause it may proceed, may be rejected in every payment whatsoever; or if offered in payment of a debt above a certain sum, may be taken according to its weight, at the then mint price, in the option of the creditor.

11. That no penalty shall be incurred by those who melt down or export the nation's coin; but that washing, clipping, or diminishing the weight of any part of it shall be deemed felony, as much as any other theft, if the person so degrading the coin shall afterwards make it circulate for lawful money.

Money.

To prevent the inconveniences proceeding from the variation in the proportion between the metals, it may be provided,

12. That upon every variation of proportion in the market price of the metals, the price of both shall be changed, according to the following rule:

Let the price of the pound troy fine gold in the coin be called G.

Let the price of ditto in the silver be called S.

Let the new proportion between the market price of the metals be called P.

Then state this formula:

$\frac{G}{2P} + \frac{S}{2} =$ to a pound troy fine silver, in sterling currency.

$\frac{S}{2} + P + \frac{G}{2} =$ to a pound troy fine gold, in sterling currency.

This will be a rule for the mint to keep the price of the metals constantly at par with the price of the market; and coinage may be imposed, as has been described, by fixing the mint price of them at a certain rate below the value of the fine metals in the coin.

13. As long as the variation of the market price of the metals shall not carry the price of the rising metal so high as the advanced price of the coin above the bullion, no alteration need be made on the denomination of either species.

14. So soon as the variation of the market price of the metals shall give a value to the rising species, above the difference between the coin and the bullion; then the king shall alter the denominations of all the coin, silver and gold, adding to the coins of the rising metal exactly what is taken from those of the other. An example will make this plain:

Let us suppose that the coinage has been made according to the proportion of 14.5 to 1; that 20 shillings, or 4 crown-pieces, shall contain, in fine silver, 14.5 times as many grains as the guinea, or the gold pound, shall contain grains of fine gold. Let the new proportion of the metals be supposed to be 14 to 1. In that case, the 20 shillings, or the 4 crowns, will contain $\frac{1}{20}$ more value than the guinea. Now since there is no question of making a new general coinage upon every variation, in order to adjust the proportion of the metals in the weight of the coins, that proportion might be adjusted by changing their respective denominations according to this formula:

Let the 20 shillings, or 4 crowns, in coin, be called S. Let the guinea be called G. Let the difference between the old proportion and the new, which is $\frac{1}{29}$ be called P. Then say.

$S - \frac{P}{2} =$ a pound sterling, and $G + \frac{P}{2} =$ a pound sterling.

By this it appears that all the silver coin must be raised in its denomination $\frac{1}{58}$, and all the gold coin must be lowered in its denomination $\frac{1}{58}$; yet still $S+G$ will be equal to two pounds sterling, as before, whether

Money. ther they be considered according to the old or according to the new denominations.

But it may be observed, that the imposition of coinage rendering the value of the coin greater than the value of the bullion, that circumstance gives a certain latitude in fixing the new denominations of the coin, so as to avoid minute fractions. For, providing the deviation from the exact proportion shall fall within the advanced price of the coin, no advantage can be taken by melting down one species preferably to another; since, in either case, the loss incurred by melting the coin must be greater than the profit made upon selling the bullion. The mint price of the metals, however, may be fixed exactly, that is, within the value of a farthing upon a pound of fine silver or gold. This is easily reckoned at the mint; although upon every piece in common circulation the fractions of farthings would be inconvenient.

15. That notwithstanding of the temporary variations made upon the denomination of the gold and silver coins, all contracts formerly entered into, and all stipulations in pounds, shillings, and pence, may continue to be acquitted according to the old denominations of the coins, paying one-half in gold and one-half in silver: unless in the case where a particular species has been stipulated; in which case, the sums must be paid according to the new regulation made upon the denomination of that species, to the end that neither profit or loss may result to any of the parties.

16. That notwithstanding the alterations on the mint price of the metals, and in the denomination of the coins, no change shall be made upon the weight of the particular pieces of the latter, except in the case of a general re-coinage of one denomination at least: that is to say, the mint must not coin new guineas, crowns, &c. of a different weight from those already in currency, although by so doing the fractions might be avoided. This would occasion confusion, and the remedy would cease to be of any use upon a new change in the proportion of the metals. But it may be found convenient, for removing the small fractions in shillings and sixpences, to recoin such denominations altogether, and to put them to their integer numbers of twelve and of six pence, without changing in any respect their proportion of value to all other denominations of the coin: this will be no great expence, when the bulk of the silver coin is put into 5 shilling pieces.

By this method of changing the denomination of the coin, there never can result any alteration in the value of the pound sterling, and although fractions of value may now and then be introduced, in order to prevent the abuses to which the coin would otherwise be exposed by the artifice of those who melt it down, yet still the inconvenience of such fractions may be avoided in paying, according to the old denominations, in both species, by equal parts. This will also prove demonstratively, that no change is thereby made in the true value of the national unit of money. Money.

17. That it be ordered, that shillings and sixpences shall only be current for 20 years; and all other coins, both gold and silver, for 40 years, or more. For ascertaining which term, there may be marked, upon the exergue of the coin, the last year of their currency, in place of the date of their fabrication. This term elapsed, or the date effaced, that they shall have no more currency whatsoever; and, when offered in payment, may be received as bullion at the actual price of the mint, or refused, at the option of the creditor.

18. That no foreign coin shall have any *legal* currency, except as bullion at the mint price.

By these and the like regulations may be prevented, 1*mo*, The melting or exporting of the coin in general. 2*do*, The melting or exporting one species, in order to sell it as bullion at an advanced price. 3*tio*, The profit in acquitting obligations preferably in one species to another. 4*to*, The degradation of the standard, by the wearing of the coin, or by a change in the proportion between the metals. 5*to*, The circulation of the coin below the legal weight. 6*to*, The profit that other nations reap by paying their debts more cheaply to Great Britain than Great Britain can pay her's to them.

And the great advantage of it is, that it is an uniform plan, and may serve as a perpetual regulation, compatible with all kinds of denominations of coins, variations in the proportion of the metals, and with the imposition of a duty upon coinage, or with the preserving it free; and further, that it may in time be adopted by other nations, who will find the advantage of having their money of account preserved perpetually at the same value, with respect to the denominations of all foreign money of account established on the same principles.——But for a fuller discussion of this subject we must refer our readers to the articles BANKING and EXCHANGE in the SUPPLEMENT, and to Mr Wheatley's Essay on the Theory of Money and Principles of Commerce, London 1807; and to a Treatise on the Coins of the Realm, in a letter to the King, by the Earl of Liverpool, London 1805.

A TABLE

A TABLE OF COINS,

Showing the Quantity of Fine Metal contained in them.

The number of grains of fine metal in every coin is sought for in the regulations of the mint of the country where it is coined, and is expressed in the grains in use in that mint. From that weight it is converted into those of other countries according to the following proportions:

3840 Troy grains, 4676.35 Paris grains, 5192.8 Holland aces or grains, and 4649.06 Colonia grains, are supposed to be equal weights; and the coins in the Table are converted according to those proportions.

TABLE of COINS reduced to Grains of fine Metal according to the Troy, Paris, Colonia, and Holland weights.

		Gold Coins.				Silver Coins.			
		Troy.	Paris.	Colonia.	Holland.	Troy.	Paris.	Colonia.	Holland.
MONEY. English Coins.	1 A Guinea by statute	118.651	144.46	143.65	160.45				
	2 A Crown by statute	— —	— —	— —	— —	429.68	523.2	520.2	581.
	3 A Shilling by statute	— —	— —	— —	— —	85.935	104.65	104.	116.2
	4 A Silver Pound Sterling by statute 1601	— —	— —	— —	— —	1718.7	2093.	2080.8	2324.1
	5 A Gold Pound Sterling by statute 1728	113.	137.61	136.8	152.8				
	6 A Silver Pound Sterling in currency=$\frac{20}{63}$lb. Troy	— —	— —	— —	— —	1639.38	1996.4	1984.7	2216.
	7 A Silver Pound Sterling at the proportion of gold to silver as 1 to $14\frac{1}{2}$	113.	137.61	136.8	152.8	1638.5	1995.3	1983.7	2215.7
	8 A Gold Pound Sterling at the same proportion of 1 to $14\frac{1}{2}$	118.4	144.18	143.34	160.11	1718.7	2093.	2080.8	2324.1
	9 A Pound Sterling at the mean proportion in gold and in silver	115.769	140.98	140.16	156.55	1678.6	2044.2	2032.2	2269.9
	10 A Shilling current=$\frac{1}{65}$ of a pound Troy	— —	— —	— —	— —	81.961	99.8	99.	110.82
	11 A Guinea in Silver or 21 Shillings standard weight	— —	— —	— —	— —	1804.6	2197.6	2184.8	2440.3
	12 A Guinea at the proportion of 1 to $14\frac{1}{2}$, worth in silver	— —	— —	— —	— —	1720.4	2095.1	2082.8	2326.4
	13 A Pound Troy, or 12 ounces English weight	5760.	7019.2	6973.5	7789.2				
French Coins.	1 A Louis d'or	113.27	137.94	137.13	153.17				
	2 A Crown of six livres	— —	— —	— —	— —	409.94	499.22	496.3	554.3
	3 A Crown of three ditto	— —	— —	— —	— —	204.97	249.61	248.15	277.1
	4 A Livre	— —	— —	— —	— —	68.34	83.23	82.74	92.42
	5 A Louis d'or, or 24 livres in silver	— —	— —	— —	— —	1639.7	1996.9	1985.2	2217.4
	6 A Marc of Paris weight, fine gold or silver	3783.87	4608.	4581.1	5116.9	3783.87	4608.	4581.1	5116.9
	7 A Marc of gold coin effective weight, in fine	3598.3	4138.5	4114.3	4593.4				
	8 A Marc of silver coin effective weight, in fine	— —	— —	— —	— —	3402.3	4143.4	4119.2	4600.9
German Coins.	1 Carolin legal weight	115.45	140.6	139.78	156.12				
	2 A Ducat of the Empire ditto	52.8	64.37	64.	71.48				
	3 A Florin of Convention	— —	— —	— —	— —	179.73	218.87	217.6	243.
	4 A Dollar of Convention	— —	— —	— —	— —	269.59	328.31	326.4	364.5
	5 A Dollar of Exchange, the Carolin=9 flor. 42 kreutzers	17.85	21.74	21.615	24.14				
	6 A Florin current=$\frac{1}{21}$ of a Carolin	10.54	12.84	12.77	14.26				
	7 A Carolin in silver, at the proportion of 1 to $14\frac{1}{2}$	— —	— —	— —	— —	1674.	2038.6	2026.8	2263.8
Dutch Coins.	1 Dutch Ducat	51.76	6.3	62.67	70.				
	2 A Florin in Silver	— —	— —	— —	— —	148.	180.3	179 2	200.21

UNIVERSAL TABLE

Of the present State of the REAL and IMAGINARY MONEYS of the WORLD.

† This mark is prefixed to the Imaginary Money, or Money of Account.

All Fractions in the Value English are Parts of a PENNY.

= This mark signifies *is*, *make*, or *equal to*.

EUROPE, Northern Parts.

ENGLAND AND SCOTLAND.

London, Bristol, Liverpoal, &c.
Edinburgh, Glasgow, Aberdeen, &c.

			L.	s.	d.
A Farthing		- - -	0	0	$0\frac{1}{4}$
2 Farthings	=	a Halfpenny -	0	0	$0\frac{1}{2}$
2 Halfpence		a Penny -	0	0	1
4 Pence		a Groat -	0	0	4
6 Pence		a Half Shilling	0	0	6
12 Pence		a Shilling -	0	1	0
5 Shillings		a Crown -	0	5	0
20 Shillings		† a Pound Sterling	1	0	0
21 Shillings		a Guinea -	1	1	0

IRELAND.

Dublin, Cork, Londonderry, &c.

A Farthing		- - -	0	0	$0\frac{3}{13}$
2 Farthings	=	a Halfpenny -	0	0	$0\frac{6}{13}$
2 Halfpence		a Penny -	0	0	$0\frac{12}{13}$
$6\frac{1}{2}$ Pence		a Half Shilling	0	0	6
12 Pence		† a Shilling Irish	0	0	$11\frac{3}{40}$
13 Pence		a Shilling -	0	1	0
65 Pence		a Crown -	0	5	0
20 Shillings		† a Pound Irish	0	18	$5\frac{1}{2}$
$22\frac{1}{4}$ Shillings		a Guinea -	1	1	0

FLANDERS AND BRABANT.

Ghent, Ostend, &c. Antwerp, Brussels, &c.

† A Pening		- - -	0	0	$0\frac{9}{160}$
4 Peningens	=	an Urche -	0	0	$0\frac{4}{160}$
8 Peningens		† a Grote -	0	0	$0\frac{9}{20}$
2 Grotes		a Petard -	0	0	$0\frac{9}{10}$
6 Petards		† a Scalin -	0	0	$5\frac{2}{3}$
7 Petards		a Scalin -	0	0	$9\frac{3}{10}$
40 Grotes		† a Florin -	0	1	6
$17\frac{1}{2}$ Scalins		a Ducat -	0	9	3
240 Grotes		† a Pound Flem.	0	9	0

HOLLAND AND ZEALAND.

Amsterdam, Rotterdam, Middleburg, Flushing, &c.

† A Pening		- - -	0	0	$0\frac{21}{1120}$
8 Peningens	=	† a Grote -	0	0	$0\frac{21}{140}$
2 Grotes		a Stiver -	0	0	$1\frac{1}{20}$
6 Stivers		a Scalin -	0	0	$6\frac{3}{10}$
20 Stivers		a Guilder -	0	1	9
50 Stivers		a Rixdollar -	0	4	$4\frac{1}{4}$

EUROPE, Northern Parts. GERMANY.

HOLLAND, &c.

			L.	s.	d.
60 Stivers	=	Dry Guilder	0	5	3
105 Stivers		a Ducat -	0	9	3
6 Guilders		† a Pound Flem.	0	10	6

HAMBURG. *Altona, Lubec, Bremen, &c.*

† A Tryling	=	- -	0	0	$0\frac{1}{128}$
2 Trylings		† a Sexling -	0	0	$0\frac{1}{64}$
2 Sexlings		a Fening -	0	0	$0\frac{1}{32}$
12 Fenings		a Shilling Lub.	0	0	$1\frac{1}{8}$
16 Shillings		† a Marc -	0	1	6
2 Marcs		a Slet Dollar -	0	3	0
3 Marcs		a Rixdollar -	0	4	6
$6\frac{1}{4}$ Marcs		a Ducat -	0	9	$4\frac{1}{2}$
120 Shillings		† a Pound Flem.	0	11	3

HANOVER. *Lunenburg, Zell, &c.*

† A Fening	=	- - -	0	0	$0\frac{7}{288}$
3 Fenings		a Dreyer -	0	0	$0\frac{7}{96}$
8 Fenings		a Marien -	0	0	$0\frac{1}{6}$
12 Fenings		a Grosh -	0	0	$0\frac{3}{4}$
8 Groshen		a Half Gulden	0	1	2
16 Groshen		a Gulden -	0	2	4
24 Groshen		† a Rixdollar -	0	3	6
32 Groshen		a Double Gulden	0	4	8
4 Guldens		a Ducat -	0	9	2

SAXONY AND HOLSTEIN.

Dresden, Leipsic, &c. Wismar, Keil, &c.

† An Heller	=	- - -	0	0	$0\frac{7}{32}$
2 Hellers		a Fening -	0	0	$0\frac{7}{16}$
6 Hellers		a Dreyer -	0	0	$0\frac{7}{32}$
16 Hellers		a Marien -	0	0	$1\frac{1}{6}$
12 Fenings		a Grosh -	0	0	$1\frac{1}{2}$
16 Groshen		a Gould -	0	2	4
24 Groshen,		† a Rixdollar -	0	3	6
32 Groshen		a Specie Dollar	0	4	8
4 Goulds		a Ducat -	0	9	4

BRANDENBURG AND POMERANIA.

Berlin, Potsdam, &c. Stetin, &c.

† A Denier	=	- - -	0	0	$0\frac{9}{1152}$
9 Deniers		a Polchen -	0	0	$0\frac{7}{128}$
18 Deniers		a Grosh -	0	0	$0\frac{7}{64}$
3 Polchens		an Abrass -	0	0	$0\frac{7}{128}$
20 Groshen		† a Marc -	0	0	$9\frac{1}{2}$

EUROPE, Northern Parts. GERMANY.

BRANDENBURG, &c.

		L.	s.	d.
30 Groshen	a Florin -	0	1	2
90 Groshen	†a Rixdollar -	0	3	6
108 Groshen	an Albertus -	0	4	2
8 Florins	a Ducat - -	0	9	4

COLOGN. *Mentz, Triers, Liege, Munich, Munster, Paderbourn*, &c.

A Dute	- - -	0	0	$0\frac{7}{30}$
3 Dutes =	a Cruitzer - -	0	0	$0\frac{21}{80}$
2 Cruitzers	an Albus - -	0	0	$0\frac{21}{40}$
8 Dutes	a Stiver - -	0	0	$0\frac{7}{10}$
3 Stivers	a Plapert - -	0	0	$2\frac{1}{10}$
4 Plaperts	a Copstuck -	0	0	$2\frac{2}{3}$
40 Stivers	a Guilder -	0	2	4
2 Guilders	a Hard Dollar -	0	4	8
4 Guilders	a Ducat - -	0	9	4

BOHEMIA, SILESIA, AND HUNGARY. *Prague, Breslaw, Presburg*, &c.

A Fening	- - -	0	0	$0\frac{7}{60}$
2 Fenings =	a Dreyer -	0	0	$0\frac{3}{10}$
3 Fenings	a Grosh -	0	0	$0\frac{7}{20}$
4 Fenings	a Cruitzer -	0	0	$0\frac{7}{15}$
2 Cruitzers	a White Grosh	0	0	$0\frac{14}{15}$
60 Cruitzers	a Gould - -	0	2	4
90 Cruitzers	†a Rixdollar -	0	3	6
2 Goulds	a Hard Dollar	0	4	8
4 Goulds	a Ducat -	0	9	4

AUSTRIA AND SWABIA. *Vienna, Trieste*, &c. *Augsburg, Blenheim*, &c.

A Fening	- - - -	0	0	$0\frac{7}{60}$
2 Fenings =	a Dreyer -	0	0	$0\frac{7}{30}$
4 Fenings	a Cruitzer -	0	0	$0\frac{7}{15}$
14 Fenings	a Grosh - -	0	0	$0\frac{49}{60}$
4 Cruitzers	a Batzen -	0	0	$1\frac{13}{15}$
15 Batzen	a Gould - -	0	2	4
90 Cruitzers	†a Rixdollar -	0	3	6
30 Batzen	a Specie Dollar -	0	4	8
60 Batzen	a Ducat -	0	9	4

FRANCONIA. *Francfort, Nuremburg, Dettingen*, &c.

A Fening	- - -	0	0	$0\frac{7}{60}$
4 Fenings	a Cruitzer -	0	0	$0\frac{7}{15}$
3 Cruitzers	a Keyser Grosh	0	0	$1\frac{2}{5}$
4 Cruitzers	a Batzen - -	0	0	$1\frac{13}{15}$
15 Cruitzers	an Ort Gould -	0	0	7
16 Cruitzers	a Gould - -	0	2	4
90 Cruitzers	†a Rixdollar -	0	3	6
2 Goulds	a Hard Dollar -	0	4	8
240 Cruitzers	a Ducat - -	0	9	4

POLAND AND PRUSSIA. *Cracow, Warsaw*, &c. *Dantzic, Koningsberg*, &c.

A Shelon	- - - -	0	0	$0\frac{7}{43}$
3 Shelons =	a Grosh -	0	0	$0\frac{7}{15}$
5 Groshen	a Coustic -	0	0	$2\frac{1}{3}$
3 Coustics	a Tinse -	0	0	7

EUROPE, Northern Parts.

POLAND, &c.

		L.	s.	d.
18 Groshen =	an Ort - -	0	0	$8\frac{3}{5}$
30 Groshen	a Florin -	0	1	2
90 Groshen	†a Rixdollar -	0	3	6
8 Florins	a Ducat -	0	9	4
5 Rixdollars	a Frederic d'Or	0	17	6

LIVONIA. *Riga, Revel, Narva*, &c.

A Blacken	- - - -	0	0	$0\frac{7}{360}$
6 Blackens =	a Grosh -	0	0	$0\frac{7}{15}$
9 Blackens	a Vording -	0	0	$0\frac{7}{10}$
2 Groshen	a Whiten -	0	0	$0\frac{14}{15}$
6 Groshen	a Marc -	0	0	$2\frac{4}{5}$
30 Groshen	a Florin -	0	1	2
90 Groshen	†a Rixdollar -	0	3	6
108 Groshen	an Albertus -	0	4	$2\frac{6}{15}$
64 Whitens	a Copperplate Dollar	0	5	0

DENMARK, ZEALAND, AND NORWAY. *Copenhagen, Sound*, &c. *Bergen, Drontheim*, &c.

A Skilling	- - -	0	0	$0\frac{9}{16}$
6 Skillings =	a Duggen -	0	0	$3\frac{3}{8}$
16 Skillings	†a Marc - -	0	0	9
20 Skillings	a Rixmarc -	0	0	$11\frac{1}{4}$
24 Skillings	a Rixort - -	0	1	$1\frac{1}{2}$
4 Marcs	a Crown - -	0	3	0
6 Marcs	a Rixdollar -	0	4	6
11 Marcs	a Ducat - -	0	8	3
14 Marcs	a Hatt Ducat -	0	10	6

SWEDEN AND LAPLAND. *Stockholm, Upsal*, &c. *Thorn*, &c.

† A Runstick	- - -	0	0	$0\frac{7}{36}$
2 Runsticks =	a Stiver -	0	0	$0\frac{7}{18}$
8 Runsticks	a Copper Marc	0	0	$1\frac{5}{9}$
3 Copper Marcs	a Silver Marc	0	0	$4\frac{2}{3}$
4 Copper Marcs	a Copper Dollar	0	0	$6\frac{2}{9}$
9 Copper Marcs	a Caroline -	0	1	2
3 Copper Dollars	a Silver Dollar	0	1	$6\frac{2}{3}$
3 Silver Dollars	a Rixdollar -	0	4	8
2 Rixdollars	a Ducat -	0	9	4

RUSSIA AND MUSCOVY. *Petersburg, Archangel*, &c. *Moscow*, &c.

A Polusca	- - -	0	9	$0\frac{27}{200}$
2 Poluscas =	a Denusca -	0	0	$0\frac{27}{100}$
2 Denuscas	†a Copec -	0	0	$0\frac{27}{50}$
3 Copecs	an Altin -	0	0	$1\frac{31}{50}$
10 Copecs	a Grievener -	0	0	$5\frac{2}{3}$
25 Copecs	a Polpotin -	0	1	$1\frac{1}{2}$
50 Copecs	a Poltin -	0	2	3
100 Copecs	a Ruble -	0	4	6
2 Rubles	a Xervonitz	0	9	0

BASIL. *Zurich, Zug*, &c.

A Rap	- - - -	0	0	$0\frac{1}{24}$
3 Rapen =	a Fening -	0	0	$0\frac{1}{8}$
4 Fenings	a Cruitzer -	0	0	$0\frac{1}{2}$
12 Fenings	†a Sol - -	0	0	$1\frac{1}{2}$

15 Fenings

EUROPE, Southern Parts.

SWITZERLAND.

BASIL, &c.

			L.	s.	d.
15 Fenings	=	a Coarse Batzen	0	0	1 7/8
18 Fenings		a Good Batzen	0	0	2 1/4
20 Sols		† a Livre -	0	2	6
60 Cruitzers		a Gulden -	0	2	6
108 Cruitzers		a Rixdollar -	0	4	6

ST GALL. *Apensal*, &c.

A Heller		- - -	0	0	0 1/16
2 Hellers	=	a Fening -	0	0	0 1/8
4 Fenings		a Cruitzer -	0	0	0 1/4
12 Fenings		† a Sol -	0	0	1 1/2
4 Cruitzers		a Coarse Batzen	0	0	2
5 Cruitzers		a Good Batzen	0	0	2 1/2
20 Sols		† a Livre -	0	2	6
60 Cruitzers		a Gould -	0	2	6
102 Cruitzers		a Rixdollar -	0	4	3

BERN. *Lucern, Neufchatel*, &c.

A Denier		- -	0	0	0 1/10
4 Deniers	=	a Cruitzer -	0	0	0 2/5
3 Cruitzers		† a Sol -	0	0	1 1/5
4 Cruitzers		a Plapert -	0	0	1 3/5
5 Cruitzers		a Gros -	0	0	2
6 Cruitzers		a Batzen -	0	0	2 2/5
20 Sols		† a Livre -	0	2	0
75 Cruitzers		a Gulden -	0	2	6
135 Cruitzers		a Crown -	0	4	6

GENEVA. *Pekay, Bonne*, &c.

A Denier		- -	0	0	0 1/30
2 Deniers	=	a Denier current	0	0	0 1/10
12 Deniers		a Small Sol -	0	0	0 3/8
12 Deniers current		a Sol current	0	0	0 3/4
12 Small Sols		† a Florin -	0	0	4 1/2
20 Sols current		† a Livre current	0	1	3
10 1/2 Florins		a Patacon -	0	3	11 1/4
15 3/4 Florins		a Croisade -	0	5	10 7/8
24 Florins		a Ducat -	0	9	0

FRANCE and NAVARRE.

Lisle, Cambray, Valenciennes, &c.

A Denier		- -	0	0	0 1/24
12 Deniers	=	a Sol -	0	0	0 1/2
15 Deniers		† a Patard -	0	0	0 5/8
15 Patards		† a Piette -	0	0	9 3/4
20 Sols		a Livre Tournois	0	0	10
20 Patards		a Florin -	0	1	0 1/2
60 Sols		an Ecu of Ex.	0	2	6
10 1/2 Livres		a Ducat -	0	9	3
24 Livres		a Louis d'Or	1	0	0

Dunkirk, St Omers, St Quintin, &c.

A Denier		- -	0	0	0 1/24
12 Deniers	=	a Sol -	0	0	0 1/2
15 Deniers		† a Patard -	0	0	0 5/8
15 Sols		† a Piette -	0	0	7 1/2
20 Sols		† a Livre Tournois	0	0	10
3 Livres		an Ecu of Ex.	0	2	6
24 Livres		a Louis d'Or	1	0	0
25 1/2 Livres		a Guinea -	1	1	0
32 2/5 Livers		a Moeda -	1	7	0

EUROPE, Southern Parts.

Paris, Lyons, Marseilles, &c. *Bourdeaux, Bayonne*, &c.

			L.	s.	d.
A Denier		- -	0	0	0 1/24
3 Deniers	=	a Liard -	0	0	0 1/8
2 Liards		a Dardene -	0	0	0 1/2
12 Deniers		a Sol -	0	0	0 2/3
20 Sols		† a Livre Tournois	0	0	10
60 Sols		an Ecu of Ex.	0	2	6
6 Livres		an Ecu -	0	5	0
10 Livres		† a Pistole -	0	8	4
24 Livres		a Louis d'Or	1	0	0

PORTUGAL. *Lisbon, Oporto*, &c.

† A Re		- - -	0	0	0 1/24
10 Rez	=	a Half Vintin	0	0	0 2/40
20 Rez		a Vintin -	0	0	1 7/80
5 Vintins		a Testoon -	0	0	6 3/4
4 Testoons		a Crusade of Ex.	0	2	3
24 Vintins		a New Crusade	0	2	8 2/5
10 Testoons		† a Milre -	0	5	7 1/2
48 Testoons		a Moeda -	1	7	0
64 Testoons		a Joanese -	1	16	0

SPAIN and CATALONIA.

Madrid, Cadiz, Seville, &c. *New Plate.*

A Maravedie		- -	0	0	0 4/765
2 Maravedies	=	a Quartil -	0	0	0 1/135
34 Maravedies		a Rial -	0	0	5 3/5
2 Rials		a Pistarine -	0	0	10 1/2
8 Rials		† a Piastre of Ex.	0	3	7
10 Rials		a Dollar -	0	4	6
375 Maravedies		† a Ducat of Ex.	0	4	11 1/2
32 Rials		† a Pistole of Ex.	0	14	4
36 Rials		a Pistole -	0	16	9

Gibraltar, Malaga, Denia, &c. *Velon.*

† A Maravedie		- -	0	0	0 1/544
2 Maravedies	=	an Ochavo -	0	0	0 1/136
4 Maravedies		† a Quartil -	0	0	0 2/68
34 Maravedies		† a Rial Velon	0	0	2 1/2
15 Rials		a Piastre of Ex.	0	3	7
512 Maravedies		† a Piastre	0	3	7
60 Rials		† a Pistole of Ex.	0	14	4
2048 Maravedies		a Pistole of Ex.	0	16	9
78 Rials		a Pistole -	0	16	9

Barcelona, Saragossa, Valencia, &c. *Old Plate.*

A Maravedie		- -	0	0	0 1/544
16 Maravedies	=	a Soldo -	0	0	3 1/8
2 Soldos		a Rial Old Plate	0	0	6 1/4
20 Soldos		† a Libra -	0	5	7 1/2
24 Soldos		† a Ducat -	0	6	9
16 Soldos		† a Dollar -	0	4	6
22 Soldos		† a Ducat -	0	6	2 1/2
21 Soldos		† a Ducat -	0	5	10 1/2
60 Soldos		a Pistole -	0	16	9

ITALY.

GENOA. *Noti*, &c. CORSICA. *Bastia*, &c.

A Denari		- -	0	0	0 1/1305
12 Denari	=	a Soldi -	0	0	0 4/1305
4 Soldi		a Chevalet	0	0	1 1/261
20 Soldi		† a Lire -	0	0	8 1/2
30 Soldi		a Testoon -	0	1	0 9/16

EUROPE, Southern Parts. ITALY.

GENOA, &c.

			L.	s.	d.
5 Lires	=	a Croisade -	0	3	7
115 Soldi		† a Pezzo of Ex.	0	4	2
6 Testoons		a Genouine	0	6	2
20 Lires		a Pistole -	0	14	4

PIEDMONT, SAVOY, AND SARDINIA.
Turin, Chamberry, Cagliari, &c.

A Denari		- - -	0	0	$0\frac{1}{16}$
3 Denari	=	a Quatrini -	0	0	$0\frac{3}{16}$
12 Denari		a Soldi -	0	0	$0\frac{3}{4}$
12 Soldi		† a Florin -	0	0	9
20 Soldi		† a Lire -	0	1	3
6 Florins		a Scudi -	0	4	6
7 Florins		a Ducatoon -	0	5	3
13 Lires		a Pistole -	0	16	3
16 Lires		a Louis d'Or	1	0	0

Milan, Modena, Parma, Pavia, &c.

A Denari		- - -	0	0	$0\frac{3}{8}$
3 Denari	=	a Quatrini -	0	0	$0\frac{9}{8}$
12 Denari		a Soldi -	0	0	$1\frac{8}{8}$
20 Soldi		† a Lire -	0	0	$8\frac{3}{4}$
115 Soldi		a Scudi current	0	4	$2\frac{1}{2}$
117 Soldi		† a Scudi of Ex.	0	4	3
6 Lires		a Philip	0	4	$4\frac{1}{2}$
22 Lires		a Pistole -	0	16	0
23 Lires		a Spanish Pistole	0	16	9

Leghorn, Florence, &c.

A Denari		- - -	0	0	$0\frac{5}{144}$
4 Denari	=	a Quatrini -	0	0	$0\frac{5}{36}$
12 Denari		a Soldi -	0	0	$0\frac{5}{12}$
5 Quatrini		a Craca -	0	0	$0\frac{25}{36}$
8 Cracas		a Quilo -	0	0	$5\frac{5}{9}$
20 Soldi		† a Lire -	0	0	$8\frac{1}{3}$
6 Lires		a Piastre of Ex.	0	4	2
$7\frac{1}{2}$ Lires		a Ducat -	0	5	$2\frac{1}{2}$
22 Lires		a Pistole	0	15	6

ROME. *Civita Vecchia, Ancona.*

A Quatrini		- - -	0	0	$0\frac{7}{10}$
5 Quatrini	=	a Bayoc -	0	0	$0\frac{3}{4}$
8 Bayocs		a Julio -	0	0	6
10 Bayocs		a Stampt Julio	0	0	$7\frac{1}{2}$
24 Bayocs		a Testoon -	0	1	6
10 Julios		a Crown current	0	5	0
12 Julios		† a Crown stampt	0	6	0
18 Julios		a Chequin -	0	9	0
31 Julios		a Pistole -	0	15	6

NAPLES. *Gaeta, Capua, &c.*

A Quatrini		- - -	0	0	$0\frac{2}{15}$
3 Quatrini	=	a Grain -	0	0	$0\frac{2}{5}$
10 Grains		a Carlin -	0	0	4
40 Quatrini		a Paulo -	0	0	$5\frac{1}{3}$
20 Grains		a Tarin -	0	0	8
40 Grains		a Testoon -	0	1	4
100 Grains		a Ducat of Ex.	0	3	4
23 Tarins		a Pistole -	0	15	4
25 Tarins		a Spanish Pistole	1	16	9

EUROPE, Southern Parts. ITALY.

SICILY AND MALTA. *Palermo, Messina, &c.*

			L.	s.	d.
A Pichila		- - -	0	0	$0\frac{1}{30}$
6 Pichili	=	a Grain -	0	0	$0\frac{2}{15}$
8 Pichili		a Ponti -	0	0	$0\frac{8}{30}$
10 Grains		a Carlin -	0	0	$1\frac{7}{15}$
20 Grains		a Tarin -	0	0	$3\frac{1}{15}$
6 Tarins		† a Florin of Ex.	0	1	$7\frac{6}{15}$
13 Tarins		a Ducat of Ex.	0	3	4
60 Carlins		† an Ounce -	0	7	$8\frac{4}{15}$
2 Ounces		a Pistole -	0	15	4

Bologna, Ravenna, &c.

A Quatrini		- - -	0	0	$0\frac{1}{10}$
6 Quatrini	=	a Bayoc -	0	0	$0\frac{3}{5}$
10 Bayocs		† a Julio -	0	0	6
20 Bayocs		a Lire -	0	1	0
3 Julios		a Testoon -	0	1	6
80 Bayocs		a Schudi of Ex.	0	4	3
105 Bayocs		a Ducatoon -	0	5	3
100 Bayocs		a Crown -	0	5	0
31 Julios		a Pistole -	0	15	6

VENICE. *Bergham, &c.*

A Picoli		- - -	0	0	$0\frac{1}{16}$
12 Picoli	=	a Soldi -	0	0	$0\frac{1}{3}$
$6\frac{1}{2}$ Soldi		† a Gros -	0	0	$2\frac{1}{6}$
18 Soldi		a Jule -	0	0	6
20 Soldi		† a Lire -	0	0	$6\frac{2}{3}$
3 Jules		a Testoon -	0	1	6
124 Soldi		a Ducat current	0	3	$5\frac{1}{3}$
24 Gros		† a Ducat of Ex.	0	4	4
17 Lires		† a Chequin	0	9	2

TURKEY. *Morea, Candia, Cyprus, &c.*

A Mangar		- - -	0	0	$0\frac{3}{20}$
4 Mangars	=	† an Asper -	0	0	$0\frac{3}{5}$
3 Aspers		a Parac -	0	0	$0\frac{4}{5}$
5 Aspers		a Bestic	0	0	3
10 Aspers		an Ostic -	0	0	6
20 Aspers		a Solota -	0	1	0
80 Aspers		† a Piastre -	0	4	0
100 Aspers		a Caragrouch	0	5	0
10 Solotas		a Xcriff -	0	10	0

ARABIA. *Medina, Mecca, Mocha, &c.*

A Carret		- - -	0	0	$0\frac{1}{8}$
$5\frac{1}{2}$ Carrets	=	a Caveer -	0	0	$0\frac{25}{200}$
7 Carrets		a Comashee -	0	0	$0\frac{9}{10}$
80 Carrets		a Larin -	0	0	$10\frac{1}{8}$
18 Comashees		an Abyss -	0	1	$4\frac{1}{5}$
60 Comashees		† a Piastre -	0	4	6
80 Cavcers		a Dollar -	0	4	6
100 Comashees		a Sequin -	0	7	6
80 Larins		† a Tomond -	3	7	6

PERSIA. *Ispahan, Ormus, Gombroon, &c.*

A Coz		- - -	0	0	$0\frac{2}{5}$
4 Coz	=	a Bisti -	0	0	$1\frac{3}{5}$
10 Coz		a Shahee -	0	0	4
20 Coz		a Mamooda	0	0	8
25 Coz		a Larin -	0	0	10
4 Shahees		an Abashee -	0	1	4

5 Abashees

ASIA.

MOGUL.

			L.	s.	d.
5 Abashees	=	an Or -	0	8	6
12 Abashees		a Bovello -	0	16	0
50 Abashees		† a Tomond -	3	6	8

GUZZERAT. *Surat, Cambay, &c.*

			L.	s.	d.
A Pecka			0	0	$0\frac{15}{64}$
2 Peckas	=	a Pice -	0	0	$0\frac{15}{32}$
4 Pices		a Fanam -	0	0	$1\frac{7}{8}$
5 Pices		a Viz -	0	0	$2\frac{17}{32}$
10 Pices		an Ana -	0	0	$7\frac{1}{2}$
4 Anas		a Rupee -	0	2	6
2 Rupees		an English Crown	0	5	0
14 Anas		a Pagoda -	0	8	9
4 Pagodas		a Gold Rupee -	1	15	0

MALABAR.

Bombay, Dabul, &c.

			L.	s.	d.
† A Budgrook		-	0	0	$0\frac{27}{800}$
2 Budgrooks	=	† a Re -	0	0	$0\frac{27}{400}$
5 Rez		a Pice	0	0	$0\frac{27}{80}$
16 Pices		a Laree	0	0	$5\frac{2}{5}$
20 Pices		a Quarter	0	0	$6\frac{3}{4}$
240 Rez		a Xeraphim	0	1	$4\frac{1}{5}$
4 Quarters		a Rupee	0	2	3
14 Quarters		a Pagoda	0	8	0
60 Quarters		a Gold Rupee	1	15	0

Goa, Visapour, &c.

			L.	s.	d.
† A Re		-	0	0	$0\frac{27}{400}$
2 Rez	=	a Bazaraco	0	0	$0\frac{27}{200}$
2 Bazaracos		a Peeka	0	0	$0\frac{27}{100}$
20 Rez		a Vintin	0	0	$1\frac{7}{20}$
4 Vintins		a Laree	0	0	$5\frac{2}{5}$
3 Larees		a Xeraphim	0	1	$4\frac{1}{5}$
42 Vintins		a Tangu	0	4	6
4 Tangus		a Paru	0	18	0
8 Tangus		a Gold Rupee	1	15	0

COROMANDEL. *Madrass, Pondicherry, &c.*

			L.	s.	d.
A Cash		-	0	0	$0\frac{5}{12}$
5 Cash	=	a Viz -	0	0	$0\frac{3}{16}$
2 Viz		a Pice -	0	0	$0\frac{3}{8}$
6 Pices		a Pieal -	0	0	$2\frac{1}{4}$
8 Pices		a Fanam -	0	0	3
10 Fanams		a Rupee -	0	2	6
2 Rupees		an English Crown	0	5	0
36 Fanams		a Pagoda -	0	8	9
4 Pagodas		a Gold Rupee	1	15	0

BENGAL. *Callicut, Calcutta, &c.*

			L.	s.	d.
A Pice		-	0	0	$0\frac{5}{12}$
4 Pices	=	a Fanam -	0	0	$0\frac{5}{6}$
6 Pices		a Viz -	0	0	$0\frac{15}{16}$
12 Pices		an Ana -	0	0	$1\frac{7}{8}$
10 Anas		a Fiano -	0	1	$6\frac{1}{4}$
16 Anas		a Rupee -	0	2	6
2 Rupees		a French Ecu	0	5	0
2 Rupees		an English Crown	0	5	0
56 Anas		a Pagoda -	0	8	9

ASIA.

SIAM. *Pegu, Malacca, Cambodia, Sumatra, Java, Borneo, &c*

			L.	s.	d.
A Cori		-	0	0	$0\frac{1}{2000}$
800 Cori	=	a Fette	0	0	$0\frac{3}{50}$
125 Fettees		a Sateleer	0	0	$7\frac{1}{2}$
250 Fettees		a Sooco	0	1	3
500 Fettees		a Tieal	0	2	6
900 Fettees		a Dollar	0	4	6
2 Ticals		a Rial	0	5	0
4 Soocos		an Ecu	0	5	0
8 Sateleers		a Crown	0	5	0

CHINA. *Pekin, Canton, &c.*

			L.	s.	d.
A Caxa		- - -	0	0	$0\frac{2}{25}$
10 Caxa	=	a Candereen -	0	0	$0\frac{4}{5}$
10 Candereens		a Mace -	0	0	8
35 Candereens		a Rupee -	0	2	6
2 Rupees		a Dollar -	0	4	6
70 Candereens		a Rixdollar -	0	4	$4\frac{1}{2}$
7 Maces		an Ecu -	0	5	0
2 Rupees		a Crown -	0	5	0
10 Maces		† a Tale -	0	6	8

JAPAN. *Jeddo, Meaco, &c.*

			L.	s.	d.
A Piti		- -	0	0	$0\frac{5}{5}$
20 Pitis	=	a Mace -	0	0	4
15 Maces		an Ounce Silver	0	4	$10\frac{1}{5}$
20 Maces		a Tale -	0	6	8
30 Maces		an Ingot -	0	9	$8\frac{1}{5}$
13 Ounces Silver		an Ounce Gold	3	3	0
2 Ounces Gold		a Japanese -	6	6	0
2 Japaneses		a Double -	12	12	0
21 Ounces Gold		† a Cattee -	66	3	0

AFRICA.

EGYPT. *Old and New Cairo, Alexandria, Sayde, &c.*

			L.	s.	d.
An Asper		- -	0	0	$0\frac{5}{80}$
3 Aspers	=	a Medin -	0	0	$1\frac{2}{5}$
24 Medins		an Italian Ducat	0	3	4
80 Aspers		† a Piastre -	0	4	0
30 Medins		a Dollar -	0	4	6
96 Aspers		an Ecu -	0	5	0
32 Medins		a Crown -	0	5	0
200 Aspers		a Sultanin -	0	10	0
70 Medins		a Pargo Dollar	0	10	0

BARBARY. *Algiers, Tunis, Tripoli, Una, &c.*

			L.	s.	d.
An Asper		- -	0	0	$0\frac{5}{80}$
3 Aspers	=	a Medin -	0	0	$1\frac{2}{5}$
10 Aspers		a Rial old Plate	0	0	$6\frac{1}{4}$
2 Rials		a Double -	0	1	$1\frac{1}{2}$
4 Doubles		a Dollar -	0	4	6
24 Medins		a Silver Chequin	0	3	4
30 Medins		a Dollar -	0	4	6
180 Aspers		a Zequin -	0	8	10
13 Doubles		a Pistole -	0	16	9

MOROCCO. *Santa Cruz, Mequinez, Fez, Tangiers, Sallee, &c.*

			L.	s.	d.
A Fluce		- -	0	0	$0\frac{1}{18}$
24 Fluces	=	a Blanquin -	0	0	2
					4 Blanquils

AFRICA.

MOROCCO, &c.

			L.	s.	d.
4 Blanquils	=	an Ounce	0	0	8
7 Blanquils		an Octavo	0	1	2
14 Blanquils		a Quarto	0	2	4
2 Quartos		a Medio	0	4	8
28 Blanquils		a Dollar	0	4	6
54 Blanquils		a Xequin	0	9	0
100 Blanquins		a Pistole	0	16	9

AMERICA. West Indies.

ENGLISH. *Jamaica, Barbadoes*, &c.

† Halfpenny			0	0	$0\frac{57}{100}$
2 Halfpence	= † a Penny		0	0	$0\frac{57}{80}$
$7\frac{1}{2}$ Pence	a Bit		0	0	$5\frac{3}{8}$
12 Pence	† a Shilling		0	0	$8\frac{11}{20}$
75 Pence	a Dollar		0	4	6
7 Shillings	a Crown		0	5	0
20 Shillings	† a Pound		0	14	3
24 Shillings	a Pistole		0	16	9
30 Shillings	a Guinea		1	1	0

FRENCH. *St Domingo, Martinico*, &c.

† A Half Sol			0	0	$0\frac{171}{640}$
2 Half Sols =	† a Sol		0	0	$0\frac{171}{320}$
$7\frac{1}{2}$ Sols	a Half Scalin		0	0	$2\frac{11}{160}$
15 Sols	a Scalin		0	0	$5\frac{3}{8}$
20 Sols	† a Livre		0	0	$7\frac{5}{160}$
7 Livres	a Dollar		0	4	6
8 Livres	an Ecu		0	4	$10\frac{1}{2}$
26 Livres	a Pistole		0	16	9
32 Livres	a Louis d'Or		1	0	0

AMERICA. Continent.

ENGLISH. *Nova Scotia, Virginia, New England*, &c.

		L.	s.	d.
† A Penny		0	0	1
12 Pence	† a Shilling	0	1	0
20 Shillings	† a Pound	1	0	0
2 Pounds				
3 Pounds				
4 Pounds	The value of the Currency al-			
5 Pounds	ters according to the Plenty or			
6 Pounds	Scarcity of Gold and Silver Coins			
7 Pounds	that are imported.			
8 Pounds				
9 Pounds				
10 Pounds				

Canada, Florida, Cayenne, &c.

† A Denier		
12 Deniers =	† a Sol.	
20 Sols	† a Livre.	
2 Livres		
3 Livres		
4 Livres	The value of the Currency al-	
5 Livres	ters according to the Plenty or	
6 Livres	Scarcity of Gold and Silver Coins	
7 Livres	that are imported.	
8 Livres		
9 Livres		
10 Livres		

Note. For all the *Spanish, Portuguese, Dutch*, and *Danish* Dominions, either on the Continent or in the West Indies, see the Moneys of the respective nations.

Money, Monk.

Ancient MONEY. See COINS and MEDALS.

Paper Money. See the article BANK.

MONK anciently denoted, "a person who retired from the world to give himself up wholly to God, and to live in solitude and abstinence." The word is derived from the Latin *monachus*, and that from the Greek μοναχος, "solitary;" of μονος, *solus*, "alone."

The origin of monks seems to have been this: The persecutions which attended the first ages of the Gospel forced some Christians to retire from the world, and live in deserts and places most private and unfrequented, in hopes of finding that peace and comfort among beasts which were denied them among men. And this being the case of some very extraordinary persons, their example gave so much reputation to retirement, that the practice was continued when the reason of its commencement ceased. After the empire became Christian, instances of this kind were numerous; and those whose security had obliged them to live separately and apart, became afterwards united into societies. We may also add, that the mystic theology, which gained ground towards the close of the third century, contributed to produce the same effect, and to drive men into solitude for the purposes of enthusiastic devotion.

The monks, at least the ancient ones, were distinguished into *solitaries*, *cœnobites*, and *sarabaites*.

The *solitary* are those who live alone, in places remote from all towns and habitations of men, as do still some of the hermits. The *cœnobites* are those who live in community with several others in the same house, and under the same superiors. The *sarabaites* were strolling monks, having no fixed rule or residence. Monk.

The houses of monks again were of two kinds, viz. *monasteries* and *lauræ*. See MONASTERY and LAURA.

Those we call monks now a-days are cœnobites, who live together in a convent or monastery, who make vows of living according to a certain rule established by the founder, and wear a habit which distinguishes their order.

Those that are endowed, or have a fixed revenue, are most properly called monks, *monachi*; as the Chartreux. Benedictines, Bernardines, &c. The Mendicants, or those that beg, as the Capuchins and Franciscans, are more properly called *religious* and *friars*; though the names are frequently confounded.

The first monks were those of St Anthony; who, towards the close of the fourth century, formed them into a regular body, engaged them to live in society with each other, and prescribed to them fixed rules for the direction of their conduct. These regulations, which Anthony had made in Egypt, were soon introduced into Palestine and Syria by his disciple Hilarion. Almost about the same time, Aones or Eugenius, with their companions Gaddanas and Azyzas, instituted the monastic order in Mesopotamia and the adjacent countries; and their example was followed with such rapid success, that

Monk. that in a short time the whole east was filled with a lazy set of mortals, who, abandoning all human connexions, advantages, pleasures, and concerns, wore out a languishing and miserable life amidst the hardships of want, and various kinds of suffering, in order to arrive at a more close and rapturous communication with God and angels.

From the east this gloomy institution passed into the west, and first into Italy and its neighbouring islands; though it is uncertain who transplanted it thither. St Martin, the celebrated bishop of Tours, erected the first monasteries in Gaul, and recommended this religious solitude with such power and efficacy, both by his instructions and his example, that his funeral is said to have been attended by no less than 2000 monks. From hence the monastic discipline extended gradually its progress through the other provinces and countries of Europe. There were besides the monks of St Basil (called in the East *Calogeri*, from καλος γερων, "good old man") and those of St Jerome, the hermits of St Augustine, and afterwards those of St Benedict and St Bernard; at length came those of St Francis and St Dominic, with a legion of others; all which see under their proper heads, BENEDICTINES, &c.

Towards the close of the fifth century, the monks, who had formerly lived only for themselves in solitary retreats, and had never thought of assuming any rank among the sacerdotal order, were now gradually distinguished from the populace, and endowed with such opulence and honourable privileges that they found themselves in a condition to claim an eminent station among the supports and pillars of the Christian community. The fame of their piety and sanctity was so great, that bishops and presbyters were often chosen out of their order; and the passion of erecting edifices and convents, in which the monks and holy virgins might serve God in the most commodious manner, was at this time carried beyond all bounds. However their licentiousness, even in this century, was become a proverb; and they are said to have excited the most dreadful tumults and seditions in various places. The monastic orders were at first under the immediate jurisdiction of the bishops, from which they were exempted by the Roman pontiff about the end of the 7th century; and the monks, in return, devoted themselves wholly to advance the interests and to maintain the dignity of the bishop of Rome. This immunity which they obtained, was a fruitful source of licentiousness and disorder, and occasioned the greatest part of the vices with which they were afterwards so justly charged. In the 8th century the monastic discipline was extremely relaxed both in the eastern and western provinces, and all efforts to restore it were ineffectual. Nevertheless, this kind of institution was in the highest esteem, and nothing could equal the veneration that was paid about the close of the 9th century to such as devoted themselves to the sacred gloom and indolence of a convent. This veneration induced several kings and emperors to call them to their courts, and to employ them in civil affairs of the greatest moment. Their reformation was attempted by Louis the Meek, but the effect was of short duration. In the 11th century they were exempted by the popes from the authority of their sovereigns, and new orders of monks were continually established; insomuch that in the council of Lateran that was held in the year 1215, a decree was passed, by the advice of Innocent III. to prevent any new monastic institutions; and several were entirely suppressed. In the 15th and 16th centuries, it appears, from the testimonies of the best writers, that the monks were generally lazy, illiterate, profligate, and licentious epicures, whose views in life were confined to opulence, idleness, and pleasure. However, the Reformation had a manifest influence in restraining their excesses, and rendering them more circumspect and cautious in their external conduct. Monk.

Monks are distinguished by the colour of their habits into *black*, *white*, *gray*, &c. Among the monks, some are called *monks of the choir*, others *professed monks*, and others *lay monks*; which last are destined for the service of the convent, and have neither clericate nor literature.

Cloistered MONKS, are those who actually reside in the house: in opposition to *extra*-monks, who have benefices depending on the monastery.

Monks are also distinguished into *reformed*, whom the civil and ecclesiastical authority have made masters of ancient convents, and put in their power to retrieve the ancient discipline, which had been relaxed; and *ancient*, who remain in the convent, to live in it according to its establishment at the time when they made their vows, without obliging themselves to any new reform.

Anciently the monks were all laymen, and were only distinguished from the rest of the people by a particular habit and an extraordinary devotion. Not only the monks were prohibited the priesthood, but even priests were expressly prohibited from becoming monks, as appears from the letters of St Gregory. Pope Syricius was the first who called them to the clericate, on occasion of some great scarcity of priests, that the church was then supposed to labour under: and since that time, the priesthood has been usually united to the monastical profession.

MONK, *George*, a personage memorable for having been the principal agent in restoring Charles II. to his crown, was descended from a very ancient family, and born in Devonshire in 1608. Being an unprovided younger son, he dedicated himself to arms from his youth, and obtained a pair of colours in the expedition to the Isle of Rhée: he served afterwards in the Low Countries with reputation, in both King Charles's northern expeditions; and did such service in quelling the Irish rebellion, that he was appointed governor of Dublin, but was superseded by parliamentary authority. Being made major-general of the Irish brigade employed in the siege of Nantwich in Cheshire, he was taken prisoner by Sir Thomas Fairfax, and remained confined in the Tower of London until the year 1646; when, as the means of obtaining liberty, he took the covenant, and accepted a command in the Irish service under the parliament. He obtained the command in chief of all the parliamentary forces in the north of Ireland, where he did signal services, until he was called to account for a treaty made with the Irish rebels; a circumstance which was only obliterated by his future good fortune. He served in Scotland under Oliver Cromwell with such success, that he was left there as commander in chief; and he was one of the commissioners for uniting that kingdom with the new erected commonwealth.

He

Monk || Monmouth.

He served at sea also against the Dutch; and was treated so kindly on his return, that Oliver is said to have grown jealous of him. He was, however, again sent to Scotland as commander in chief, and continued there five years; when he dissembled so well, and improved circumstances so dexterously, that he aided the desires of a wearied people, and restored the king without any disturbance: for which he was immediately rewarded both with honours and profit: (See Britain, N° 194, &c.). He was created duke of Albemarle, with a grant of 7000l. per annum estate, beside other emoluments; and enjoyed the confidence of his master without forfeiting that of the people. After his death in 1670, there was published a treatise composed by him while he remained prisoner in the Tower, entitled, "Observations on Military and Political Affairs," a small folio.

Monk-Fish. See Squalus, Ichthyology *Index.*

Monk's Head, or *Wolf's bane.* See Aconitum, Botany *Index.*

MONKEY. See Simia, Mammalia *Index.*

MONMOUTH, James, Duke of, son to Charles II. by Mrs Lucy Walters, was born at Rotterdam in 1649. Upon the Restoration, he was called over to England, where the king received him with all imaginable joy, created him earl of Orkney (which was changed into that of Monmouth), and he took his seat in the house of peers in the ensuing session of parliament. He married Anne, the heiress of Francis earl of Buccleugh; and hence it came to pass that he had also the title of *Buccleugh*, and took the surname of *Scot*, according to the custom of Scotland. In 1668 his father made him captain of his life-guard of horse; and in 1672 he attended the French king in the Netherlands, and gave proofs of bravery and conduct. In 1673 the king of France made him lieutenant-general of his army, with which he came before Maestricht, and behaved himself with incredible gallantry, being the first who entered it himself. He returned to England, was received with all possible respect, and was received chancellor of the university of Cambridge. After this he went to assist the prince of Orange to raise the siege of Mons, and did not a little contribute towards it. He returned to England; and was sent in quality of his father's general, to quell an insurrection in Scotland, which he effected; but soon after he fell into disgrace; for, being a Protestant, he was deluded into ambitious schemes, upon the hopes of the exclusion of the duke of York: he conspired against his father and the duke; and when the latter came to the throne by the title of *James II.* he openly appeared in arms, encouraged by the Protestant army; but coming to a decisive battle before he had sufficient forces to oppose the royal army, he was defeated, taken soon after concealed in a ditch, tried for high treason, condemned, and beheaded in 1685, aged 36. See Britain, N° 242, 249—265.

Monmouth, the capital of the county of Monmouthshire in England, 129 miles from London, and 33 miles from Bristol. It has its name from its situation at the conflux of the Monow or Mynwy, and the Wye, over each of which it has a bridge, and a third over the Frothy. Here was a castle in William the Conqueror's time which Henry III. took from John baron of Monmouth. It afterwards came to the house of Lancaster, who bestowed many privileges upon the town. Here Henry V. surnamed *of Monmouth*, was born. The famous historian Geoffrey was also born at this place. Formerly it gave the title of *earl* to the family of Carey, and of *duke* to King Charles the Second's eldest natural son; but now of *earl* to the Mordaunts, who are also earls of Peterborough. It contained 3503 inhabitants in 1811, is well built, carries on a considerable trade with Bristol by means of the Wye, and has a weekly market, and three fairs.

Monmouth || Monody.

MONMOUTHSHIRE, a county of England; anciently reckoned a part of Wales, but in Charles II.'s time taken into the Oxford circuit, and made an English county. It is bounded on the north by Herefordshire, on the east by Gloucestershire, on the south by the river Severn, and on the west by the Welsh counties of Brecknock and Glamorgan. Its extent from north to south is about 30 miles, from east to west 26, and in circumference 110. It is subdivided into six hundreds, and 127 parishes. In 1811, this county contained 12,127 houses, and 62,127 inhabitants. It sends only three members to parliament, that is, one for Monmouth, and two for the county. The air is temperate and healthy; and the soil fruitful, though mountainous and woody on the western side. The hills feed sheep, goats, and horned cattle; and the valleys produce plenty of grass and corn. This county is extremely well watered by several fine rivers; for, besides the Wye, which parts it from Gloucestershire, the Mynow, which runs between it and Herefordshire, and the Rumney, which divides it from Glamorganshire, it has, peculiar to itself, the Usk, which enters this county a little above Abergavenny, runs mostly southward, and falls into the Severn by the mouth of the Ebwith; which last river runs from north to south, in the western side of the county. All these rivers, especially the Wye and Usk, abound with fish, particularly salmon and trout.

MONOCEROS, Unicorn, in *Astronomy*, a southern constellation formed by Hevelius, containing in his catalogue 19 stars, and in the Britannic Catalogue 31.

Monoceros. See Monodon, Cetology *Index.*

MONOCHORD; an instrument by which the several proportions of musical sounds and intervals, as well in the natural as in tempered scales are tried. Originally it had, as its name implies, only one string; but it is better constructed with two; for, by means of this additional string, we have an opportunity of judging of the harmony of two tempered notes in every possible variety of temperament.

The reader who may wish for further information respecting the construction and use of monochords, may consult the appendix to Mr Atwood's Treatise on Rectilinear Motion, and Mr Jones's observations on the scale of music, monochord, &c. in his Physiological Disquisitions.

Monochord is also used for any musical instrument that consists of only one string or chord; in this sense the trumpet marine may properly be called a *monochord.*

MONOCULUS, a genus of insects of the order of *aptera.* See Entomology *Index.*

MONODON, a genus of fishes belonging to the order of *cete.* See Cetology *Index.*

MONODY, in ancient poetry, a mournful kind of song,

Monoly ‖ Monophysites.

song, sung by a person all alone, to give vent to his grief. The word is derived from μονος, "alone," and ᾀδω, "I sing."

MONOECIA, from μονος, *alone*, and οικος, a *house*; the name of the 21st class in Linnæus's sexual method. See BOTANY.

MONOGAMY, compounded of μονος, *solus*, and γαμος, "marriage," the state or condition of those who have only married once, or are restrained to a single wife. See POLYGAMY.

MONOGLOSSUM, in *Ancient Geography*, a mart town of the Hither India, situated on the Sinus Canthi, into which the Indus empties itself. Said to be Mangalor on the coast of Malabar. E. Long. 74°, N. Lat. 13°.

MONOGRAM, a character or cypher, composed of one, two, or more letters interwoven; being a kind of abbreviation of a name, anciently used as a seal, badge, arms, &c.

MONOGYNIA, from μονος, *alone*, and γυνη, a *woman*; the name of the first order or subdivision in the first 13 classes of Linnæus's sexual method; consisting of plants which, besides their agreement in their classic character, generally derived from the number of their stamina, have only one style.

MONOMOTAPA, a country of Southern Africa, lying north-eastward of the Cape of Good Hope. The air of this country is very temperate; the land fertile in pastures and all the necessaries of life, being watered by several rivers. The inhabitants are rich in black cattle, which they value more than gold. They have a vast number of elephants, as appears from the great quantity of ivory that is exported. There is also a considerable trade in gold dust. This country is divided into seven provinces or petty kingdoms, vassals to the king; viz. Monomotapa Proper, Quiteve, Manica, Inhambana, Inhemior, Sabia, and Sofala.

MONONGAHELA, a river of North America, which rises in the Laurel mountains in Virginia, and after a course of about 200 miles, joins the Alleghany at Pittsburg. The two rivers united then form the Ohio. The Monongahela is navigable for boats about 100 miles.

MONOPETALOUS, in *Botany*, a term applied to flowers that have only one petal or flower-leaf.

MONOPHYSITES, (from μονος, *solus*, and φυσις, *natura*), a general name given to all those sectaries in the Levant who only own one nature in Jesus Christ; and who maintain, that the divine and human natures of Christ were so united as to form only one nature, yet, without any change, confusion, or mixture of the two natures.

The *Monophysites*, however, properly so called, are the followers of Severus, a learned monk of Palestine, who was created patriarch of Antioch in 513, and Petrus Fullensis.

The Monophysites were encouraged by the emperor Anastasius, but depressed by Justin and succeeding emperors. However, this sect was restored by Jacob Baradæus an obscure monk, insomuch that when he died bishop of Edessa, A. D. 588, he left it in a most flourishing state in Syria, Mesopotamia, Armenia, Egypt, Nubia, Abyssinia, and other countries. The laborious efforts of Jacob were seconded in Egypt and the adjacent countries, by Theodosius bishop of Alexandria; and he became so famous that all the Monophysites of the east considered him as their second parent and founder, and are to this day called *Jacobites*, in honour of their new chief. The Monophysites are divided into two sects or parties, the one African, the other Asiatic; at the head of the latter is the patriarch of Antioch, who resides for the most part in the monastery of St Ananias, near the city of Merdin: the former are under the jurisdiction of the patriarch of Alexandria, who generally resides at Grand Cairo, and are subdivided into Cophts and Abyssinians. From the 15th century downwards, all the patriarchs of the Monophysites have taken the name of *Ignatius*, in order to show that they are the lineal successors of Ignatius, who was bishop of Antioch in the first century, and consequently the lawful patriarch of Antioch. In the 17th century, a small body of the Monophysites in Asia abandoned for some time the doctrine and institution of their ancestors, and embraced the communion of Rome: but the African Monophysites, notwithstanding that poverty and ignorance which exposed them to the seductions of sophistry and gain, stood firm in their principles, and made an obstinate resistance to the promises, presents, and attempts employed by the papal missionaries to bring them under the Roman yoke: and in the 18th century, those of Asia and Africa have persisted in their refusal to enter into the communion of the Romish church, notwitstanding the earnest entreaties and alluring offers that have been made from time to time by the pope's legates, to conquer their inflexible constancy. The Monophysites propagate their doctrine in Asia with zeal and assiduity, and have not long ago gained over to their communion a part of the Nestorians, who inhabit the maritime coast of India.

Monophysites. Monopoly

MONOPOLY, one or more persons making themselves the sole masters of the whole of a commodity, manufacture, and the like, in order to make private advantage of it, by selling it again at a very advanced price. Or it is a license or privilege allowed by the king for the sole buying and selling, making, working, or using any thing whatsoever.—Monopolies had been carried to an enormous height during the reign of Queen Elizabeth; and were heavily complained of by Sir Edward Coke, in the beginning of the reign of King James I.: but were in great measure remedied by statute 21 Jac. I. c. 3. which declares such monopolies to be contrary to law, and void; (except as to patents, not exceeding the grant of 14 years, to the authors of new inventions; and except also patents concerning printing, saltpetre, gunpowder, great ordnance, and shot); and monopolists are punished with the forfeiture of treble damages and double costs, to those whom they attempt to disturb; and if they procure any action, brought against them for these damages, to be stayed by any extrajudicial order, other than of the court wherein it is brought, they incur the penalties of *præmunire*. Combinations also among victuallers or artificers, to raise the price of provisions, or any commodities, or the rate of labour, are in many cases severely punished by particular statutes; and, in general, by statute 2 and 3 Edward VI. c. 15. with the forfeiture of 10l. or 20 days imprisonment, with an allowance of only bread and water, for the first offence; 20l. or the pillory for the second; and 40l. for the third, or else the pillory, loss of one ear, and perpetual infamy.

Monopoly || Monro.

By a constitution of the emperor Zeno, all monopolies and combinations to keep up the price of merchandise, provisions, or workmanship, were prohibited, upon pain of forfeiture of goods and perpetual banishment. See COMMERCE and CORN LAWS, SUPPLEMENT.

MONOSYLLABLE, in *Grammar*, a word that consists only of one syllable, and is composed either of one or more letters pronounced at the same time. The too frequent use of monosyllables has a very bad effect in English poetry, as Mr Pope both intimates and exemplifies in the same verse, viz.

"And ten slow words oft creep in one dull line."

MONOTHELITES, (compounded of μονος, "single,', and θελημα, "will," of θελω, *volo*, "I will,") an ancient sect, which sprung out of the Eutychians; thus called, as only allowing of one will in Jesus Christ.

The opinion of the Monothelites had its rise in 630, and had the emperor Heraclius for an adherent: it was the same with that of the Acephalous Severians. They allowed of two wills in Christ, considered with regard to the two natures; but reduced them to one, by reason of the union of the two natures; thinking it absurd there should be two free wills in one and the same person. They were condemned by the sixth general council in 680, as being supposed to destroy the perfection of the humanity of Jesus Christ, depriving it of will and operation. Their sentiments were afterwards embraced by the Maronites.

MONOTONY, an uniformity of sound, or a fault in pronunciation, when a long series of words is delivered in one unvaried tone. See READING.

MONOTROPA, BIRD'S-NEST; a genus of plants belonging to the monandria class; and in the natural method ranking with those of which the order is doubtful. See BOTANY *Index*.

MONREAL. See MONTREAL.

MONRO, DR ALEXANDER, senior, a celebrated physician and anatomist, was the son of Mr John Monro, who was for some years a surgeon in the army under King William in Flanders, and who afterwards settled as a surgeon in Edinburgh. The subject of this biographical sketch was born in London in 1697.

He showed an early inclination to the study of physic; and the father, after giving him the best education that Edinburgh then afforded, sent him successively to London, Paris, and Leyden, to improve himself further in his profession. At London, he attended the lectures of Messrs Hawksbee and Whiston on experimental philosophy, and the anatomical demonstrations of Mr Cheselden. At Paris he attended the hospitals, and the lectures on the different branches of physic and surgery; and towards the end of autumn 1718, he went to Leyden, and studied under the great Boerhaave.

On his return to Edinburgh in autumn 1719, Messrs Drummond and Macgill, who were then conjunct nominal professors and demonstrators of anatomy to the Surgeons Company, having resigned in his favour, his father prevailed on him to read some public lectures on anatomy, and to illustrate them by showing the curious anatomical preparations which he had made and sent home when abroad. He at the same time persuaded Dr Alston, then a young man, to give some public lectures on botany. Accordingly, in the beginning of the winter 1720, these two young professors began to give regular courses of lectures, the one on the materia medica and botany, the other on anatomy and surgery; which were the first regular courses of lectures on any of the branches of medicine that had ever been read at Edinburgh, and may be looked upon as the opening of that medical school which has since acquired such great reputation all over Europe. Monro.

In summer 1721 and 1722, Dr Monro, by the persuasion of his father, read some lectures on chirurgical subjects, particularly on wounds and tumours, which he never would publish, having written them in a hurry and before he had much experience; but inserted from time to time the improvements he thought might be made in surgery, in the volumes of Medical Essays and Observations to be hereafter mentioned.

About the year 1720, his father communicated to the physicians and surgeons at Edinburgh, a plan which he had long formed in his own mind, of having the different branches of physic and surgery regularly taught at Edinburgh; which was highly approved of by them, and by their interest regular professorships of anatomy and medicine were instituted in the university. His son, Dr Monro, was first made university professor of anatomy; and two or three years afterwards, Drs Sinclair, Rutherford, Innes, and Plummer, were made professors of medicine; the professorship of materia medica and botany, which Dr Alston then held, having been added to the university many years before. Immediately after these gentlemen were elected professors, they began to deliver regular courses of lectures on the different branches of medicine, and they and their successors have uniformly continued so to do every winter.

The plan for a medical education at Edinburgh was still incomplete without an hospital, where students could see the practice of physic and surgery, as well as hear the lectures of the professors. A scheme was therefore proposed by Dr Monro's father, and others, particularly the members of the Royal College of Physicians and Board of Surgeons, for raising by subscription a fund for building and supporting an hospital for the reception of diseased poor; and our author published a pamphlet setting forth the advantages that would attend such an institution. In a short time a considerable sum of money was raised, a small house was fitted up, and patients were admitted into it, and regularly attended by many of the physicians and surgeons in town. The fund for this charity increasing very considerably, in a great measure from the activity and influence of that very worthy citizen and magistrate George Drummond, Esq. the foundation was laid of the present large, commodious, and useful hospital, the *Royal Infirmary*; in the planning of which Dr Monro suggested many useful hints, and in particular the elegant room for chirurgical operations was designed and executed under his direction. Provost Drummond and he were nominated the building committee; and the fabric was entirely completed in a short space of time. It has since been so largely endowed, as to be capable of receiving a great number of diseased poor, whose cases the students of physic and surgery have an opportunity of seeing daily treated with the greatest attention and care by physicians and surgeons eminent in their profession; and a register of the particulars of all the cases which have been received

Monro

received into the house since its first opening has been kept, in books appropriated for that purpose, for the use of the students.

In order to make the hospital of still farther use to the students, Dr Monro frequently, while he continued professor of anatomy, gave lectures on the chirurgical cases; and Dr Rutherford, then professor of the practice of physic, began, in the year 1748, to deliver clinical lectures, to be continued every winter, on the most remarkable cases in the hospital.

Dr Monro, though he was elected professor of anatomy in the year 1721, was not received into the university till the year 1725, when he was inducted along with that great mathematician the late Mr Colin Maclaurin, with whom he ever lived in the strictest friendship. From this time he regularly every winter gave a course of lectures on anatomy and surgery, from October to May, upon a most judicious and comprehensive plan: A task in which he persevered with the greatest assiduity, and without the least interruption, for near 40 years; and so great was the reputation he had acquired, that students flocked to him from the most distant corners of his majesty's dominions.

In 1759, our professor entirely relinquished the business of the anatomical theatre to his son Dr Alexander, who had returned from abroad, and had assisted him in the course of lectures the preceding year. But after this resignation, he still endeavoured to render his labours useful to makind, by reading clinical lectures at the hospital for the improvement of the students; of which Dr Duncan, who was one of his pupils, has given the following account. "There I had myself the happiness of being a pupil, who profited by the judicious conduct of his practice, and was improved by the wisdom and acuteness of his remarks. I have indeed to regret that I attended only the last course of lectures in which he had ever a share, and at a time when he was subjected to a disease which proved at length fatal. Still, however, from what I saw and from what I heard, I can venture to assert, that it is hardly possible to conceive a physician more attentive to practice, or a preceptor more anxious to communicate instructions. His humanity, in the former of these characters, led him to bestow the most anxious care on his patients while they were alive; and his zeal in the latter induced him to make them the subject of useful lessons when they happened to die.—In the different stations of physician, of lecturer, and of manager in the hospital, he took every measure for inquiring into the causes of diseases by dissection.—He personally attended the opening of every body; and he not only dictated to the students an accurate report of the dissection, but with nice discrimination contrasted the diseased and sound state of every organ. Thus, in his own person he afforded to the students a conspicuous example of the advantages of early anatomical pursuits, as the happiest foundation for a medical superstructure. His being at once engaged in two departments, the anatomical theatre and clinical chair, furnished him with opportunities both on the dead and living body, and placed him in the most favourable situation for the improvement of medicine; and from these opportunities he derived every possible advantage which they could afford."

His father, old Mr Monro, lived to an advanced age; and enjoyed the unspeakable pleasure of beholding a son, esteemed and regarded by mankind, the principal actor in the execution of his favourite plan, the great object of his life, the founding a seminary of medical education in his native country: The son, who survived him near 30 years, had the satisfaction to behold this seminary of medical education frequented yearly by 300 or 400 students, many of whom came from the most distant corners of his majesty's dominions, and to see it arrive to a degree of reputation far beyond his most sanguine hopes, being equalled by few, and inferior to none, in Europe.

Monro.

Dr Monro was not only very active in the line of his own profession, but as a citizen and general member of the community; for, after he had resigned the anatomical chair to his son, he executed with the strictest punctuality the duties of several engagements both of a civil and political nature: He was a director of the Bank of Scotland, a justice of the peace, a commissioner of high roads, &c. At length, after a life spent in the most active industry, he became afflicted with a tedious and painful disease, which he bore with equal courage and resignation till his death, which happened on July 10. 1767, in the 70th year of his age.

Of his works, the first in order is his Osteology, which was written for the use of students, but is capable also of affording instruction to the oldest and most experienced practitioner; as, besides a minute description of the parts copied from nature, it everywhere abounds with new and important observations immediately applicable to practice. It has been translated into many different languages; has passed through numerous editions; and has been reprinted in foreign countries in the most superb manner, accompanied with elegant and masterly engravings. His description of the Lacteal Sac and Thoracic Duct contains the most accurate account of that important part of the body which has been yet published; and his Anatomy of the Nerves will transmit to posterity an excellent example of accurate dissection, faithful description, and ingenious reasoning. The six volumes of Medical Essays and Observations, published by a society in Edinburgh, are universally known and esteemed. To that society he was appointed secretary; but, after the publication of the first volume, to which he had largely contributed, the members growing remiss in their attendance, he became the sole collector and publisher of the work: To him we are therefore in a great measure indebted for those numerous and important discoveries with which this publication has enriched every department of medical knowledge. In the two first volumes of the Physical and Literary Essays, published by the physical society of Edinburgh, in which he had the rank of one of the presidents, we find several papers written by him, which are not the least ornaments of that collection. His account of the Success of Inoculation in Scotland may be considered as his last publication: It demonstrates his extensive correspondence and indefatigable industry, and has had great influence in promoting that salutary practice. Besides these, he was also the author of several other elegant and masterly productions, which were either never published, or were published without his knowledge and from incorrect copies. A collection of all his works, properly arranged, corrected, and illustrated with copperplates, has been published by Dr

Monro || Monselemines.

Alexander Monro, his son and successor in the anatomical chair, in a splendid quarto volume, printed for Elliot, Edinburgh, 1781; to which is prefixed a life of the author, by another of his sons, Dr Donald, physician in London. The observation of an excellent judge, the illustrious Haller, concerning our author's Medical Essays and Observations, which now form a part of this collection, may with no less justice be applied to the whole: "It is a book which ought to be in the possession of every medical practitioner."

MONS, an ancient, large, handsome, rich, and very strong city of the Netherlands. It is situated on an uneven and marshy soil on the river Trouille. In the neighbourhood are extensive coal mines which are worked. It has several manufactures, and a good trade. It was taken by the allies in 1709, and by the French in July 1746; but rendered back by the treaty of Aix-la-Chapelle, after the fortifications were demolished. It was taken by the French in 1794, and while in their possession was chief town of the department of Jemappe. It was separated from France at the peace of Paris in 1814, and annexed to the kingdom of the Netherlands. The population in 1800 was 18,291. E. Long. 3. 51. N. Lat. 50. 25.

Mons Sacer, in *Ancient Geography*, a mountain of the Sabines beyond the Anio, to the east of Rome; whither the common people retired once and again to avoid the tyranny of the Patricians. From this secession, and the altar of *Jupiter Terribilis* erected there, the mountain took its name.

MONSEIGNEUR, in the plural *Messeigneurs*, a title of honour and respect used by the French in writing to persons of superior rank or quality.

Dukes, peers, archbishops, bishops, and presidents *à la mortier*, were complimented with the title of *Monseigneur*. In the petitions presented to the sovereign courts, they used the term *Messeigneurs*.

MONSEIGNEUR, absolutely used, was a title restrained to the dauphin of France. This custom was unknown till the time of Louis XIV. before which the dauphin was styled *Monsieur le Dauphin*.

MONSELEMINES, a people inhabiting that part of Biledulgerid, which borders on the territories of the emperor of Morocco. They are a mixed race, descended from the ancient Arabs and fugitive Moors. Their country extends from about 90 miles beyond Cape Non, to the distance of 60 miles from St Croix. It is mostly fertile; and, with little cultivation, produces the necessaries of life. A number of streams water the plains, which abound with fig, date, palm, and almond trees. The gardens produce excellent grapes, which the Jews convert into brandy after they have been dried by the Arabs.

The Monselemine territory is very populous, and would be much more so, were it not for the almost continual wars in which the people are engaged against the emperor of Morocco; for, as this country is the retreat of the rich Moors, who wish to fly from the tyranny of the emperor, they are too well acquainted with the Moorish customs to be surprised by that prince. As soon as a Moorish army takes the field, the inhabitants mount their horses, and occupy the passes of the mountains; while the women and slaves retire to the interior parts of the country, or to the desert, if they are hard pressed. Their horses, which they break in an admirable manner, are said to be the best in the world; obedient to the voice of their master, and allowing no stranger to mount them. Monselemines || Mousoon

The people derive their name and origin from one Moseilama, who was contemporary with Mahomet. They respect the prophet, as do other Mahometans; but neither believe that he was infallible, nor that his descendants are all inspired by God, nor that their will should be a law, nor that such faith is necessary in order to be a good Mahometan. The influence of their high priest is nearly despotic; for though he has no troops, he may command the nation, and peace and war depend upon his will. He has no property, yet every thing is at his disposal; he requires nothing from any, yet all are disposed to give him.

The Monselemines, on Friday, meet in their mosques for prayer, and the same is likewise the day of their principal market, when their goods are exposed to sale in the public squares. They never attempt to make proselytes; and they treat their Christian slaves with humanity, which may perhaps be owing to the avarice of their masters. The Jews are allowed among them the free exercise of their religion. Polygamy is permitted among them; but the situation of the women is more respectable, and they are not so much secluded as among the Moors, mingling more in society, walking at large, and visiting their friends. The Monselemine children are brought up with great care, and are not obliged to exhibit proofs of their courage till they can be considered as men.

MONSIEUR, in the plural *Messieurs*, a term or title of civility, used by the French in speaking to their equals, or those a little below them, answering to *Mr* or *Sir* among the English.

MONSIEUR, absolutely used, was a title appropriated to the second son of France, or the king's brother. The king was also called *Monsieur*, but that only by the children of France.

MONSONIA, a genus of plants belonging to the polyadelphia class. See BOTANY *Index*.

MONSOON, a regular or periodical wind, in the East Indies, blowing constantly the same way, during six months of the year, and the contrary way the remaining six.

In the Indian ocean, the winds are partly general, and blow all the year round the same way, as in the Ethiopic ocean; and partly periodical, i. e. half the year blow one way, and the other half year on the opposite points: and those points and times of shifting differ in different parts of this ocean. These latter are what we call *monsoons*.

The shifting of these monsoons is not all at once; and in some places the time of the change is attended with calms, in others with variable winds, and particularly those of China, at ceasing to be westerly, are very subject to be tempestuous; and such is their violence, that they seem to be of the nature of the West India hurricanes, and render the navigation of those seas very unsafe at that time of the year. These tempests the seamen call the *breaking up of the monsoons*.

Monsoons, then, are a species of what we otherwise call *trade winds*. They take the denomination *monsoon* from an ancient pilot, who first crossed the Indian sea by means hereof. Though others derive the name from

Monsoon, Monster.

from a Portnguese word signifying motion or change of wind and sea.

Lucretius and Apollonius make mention of anuual winds which arise every year, *etesia flabria*, which seem to be the same with what in the East Indies we now call *monsoons*. For the physical cause of these winds, see METEOROLOGY.

MONSTER; a birth or production of a living being, degenerating from the proper and usual disposition of parts in the species to which it belongs: As, when there are too many members, or too few; or some of them are extravagantly out of proportion, either on the side of defect or excess. The word comes from the Latin *monstrum*, of *monstrando*, "showing." Whence also the box wherein relicks were anciently kept to be shown, was called *monstrum*. Dugdale mentions an inventory of the church of York with this article, *Item unum monstrum cum ossibus sancti Petri in beryl, et crucifixo in summitate.*

Aristotle defines a monster to be a defect of nature, when, acting towards some end, it cannot attain to it, from some of its principles being corrupted.

Monsters do not propagate their kind; for which reason some rank *mules* among the number of monsters, as also *hermaphrodites*.

Females which bring forth twins, are found most liable to produce monsters. The reason, probably, is owing to this; that though the twins are covered with one common chorion, yet they have each their separate amnios, which by their contiguity may chance to grow together, and so occasion a confusion or blending of the parts. Hence so many double creatures.

Various theories have been proposed by philosophers and physiologists to account for the production of monsters. But after all, it must be confessed, that we are very little acquainted with those deviations from the ordinary course of nature. For each organized being there appears to exist a primitive germ or model of the different species drawn by the Creator, determined by forms and sexes, and realized in the individuals of both sexes, which must unite in order to their reproduction. From this model nature never departs, unless when compelled by circumstances which derange the primitive organization common to the species, and produce what are called *monsters*.

With respect to structure, monsters are of various kinds. Some have an excess or defect in certain parts; such as those which are called *acephalous*, or who want the head; those which have two heads, two arms, two legs, and one body, or which have two bodies and one head, or which have three legs; and those which want the arms or the legs. Others err through an extraordinary and deformed conformation, through an unnatural union of certain parts or viscera, through a great derangement in one or more of their members, and through the extraordinary place which these often occupy in consequence of this derangement or transposition. The monster described by Dr Eller of the academy of Berlin was of this kind. It was a fœtus of nine months, 28 inches long, with an enormous head and frightful countenance; and in the middle of a broad and vast forehead it had a reddish eye, without either eyebrows or eyelids, and sunk deep into a square hole. Immediately below this eye was an excrescence which strongly resembled a penis with a glans, a prepuce, and an urethra: the part covered with hair was likewise below the nape of the neck. In other monsters we meet with the unnatural union of some parts, which from their destination and functions, ought always to be separate; and the separation of other parts, which, for the same reasons, ought constantly to be united. The reader may see the different ways in which the formation of monsters takes place, in four memoirs by M. Lemery, inserted in *L'Histoire de l'Academie des Sciences*, 1738 and 1739. M. du Verney has likewise published a memoir on the same subject.

Monster.

In the volume published by the Academy of Sciences in 1724, mention is made by M. Geoffroy of a monster born in Barrois 1722. This monstrous production consisted of two children without the inferior extremities, joined together by a common navel: each of them had a nurse, sucked, and eat pap; and the one sucked while the other slept. The reader may likewise consult the second part of Winslow's Memoirs on Monsters, inserted in the volume published by the Academy of Sciences in 1734, where he will find the history of two very extraordinary twin monsters, who evidenced during their life a great difference in their moral and physical qualities. We are obliged simply to refer to these Memoirs, as they are too long for abridgement.

It is observed by Haller, that in some monsters the natural structure is changed by some shock or passion: in others the structure, independent of any accident, is originally monstrous; such as when all the members are reversed from left to right, when the person has six fingers, and in many other instances. M. de Maupertuis mentions, that there is at Berlin a family who have had six fingers on each hand for several generations. M. de Riville saw an instance of this at Malta, of which he has given a description. M. Renou, surgeon at Pommeraye in Anjou, has published an account of some families with six fingers, which are to be found in several parishes of the Lower Anjou, and which have existed there from time immemorial. This deformity is perpetuated in these families even when they intermarry with persons who are free from it. Whether the propagation of these supernumerary organs, which are not only useless but inconvenient and even disagreeable, be owing to the father or mother, their children of both sexes are subject to it indiscriminately. A father and mother with six fingers frequently have a part, and sometimes the whole of their children, free from this deformity; but it again makes its appearance, and in a very great degree, in the third generation. From this it appears, that this fault in the conformation is hereditary. M. Reaumur has likewise published the history of a family in the island of Malta, the children of which are born with six fingers and six toes. But it deserves to be inquired, Whether these supernumerary fingers are real fingers? The reader may here consult the *Journal de Physique* for November 1774, p. 372. This variety of *scadigitary* hands and feet is not comprehended in the *Researches sur quelques conformations monstrueuses des doigts dans l'homme*, which is inserted in the Memoirs of the Academy of Sciences for 1771. In the *Journal de Physique* for August 1776, we find a description of a double uterus and vagina observed in a woman who died in childbed, by Dr Purcell of Dublin: and in that for June

1788,

Monster. 1788, we have an account of a man with seven fingers on each hand, by Baron Dietrich.

Several monstrous productions are to be seen in the cabinet at Chantilly. 1. Two calves joined together in the body, with each a separate head and neck, and four legs in whole. 2. Two calves united only by the pelvis, with only one anus and one tail: the whole is supported by six legs, four before and two behind. 3. A lamb with six legs, four of which are behind. 4. The skeleton of a ram, which has likewise six legs. 5. A hermaphrodite deer. 6. The head of a foal, which has only one eye in the middle of the forehead. 7. Some leverets with six and eight legs. 8. A puppy, the lips of which are divided four-fold. 9. Some fœtuses of a hog which have a kind of tube upon their forehead one or two inches long; and another, the hinder part of which is double in every thing. 10. Two double human fœtuses joined by the belly, with four arms and three legs. 11. A young chicken with two bodies and one head. 12. A pigeon and a duck, each with two bills. 13. A duck with two heads. 14. A pigeon with four feet. 15. A capon with three feet; the third being fixed to the anus. 16. Two heads of a calf joined together, each of them with two ears: these two heads were both fixed to one neck. 17. In the *Menagerie* at Chantilly there was formerly to be seen a cow with five feet, the fifth of which was connected with the dug. 18. A rabbit without ears. 19. Two cats, each having two heads. 20. Two leverets newly brought forth, well shaped in the body and legs, but connected together by means of only one head. 21. Several eggs, in the figure of which there occur some monstrous appearances and extraordinary deformities, sufficient to show that they are contrary to the established form of nature.

Mr Home, surgeon, some time ago presented to Mr John Hunter, the *double skull* of a child, born at Calcutta in May 1783 of poor parents aged 30 and 35, and which lived to be nearly two years old. The body of this child was naturally formed: but the head had the phenomenon of appearing double; another head of the same size, and almost equally perfect, being attached to its upper part. In this extraneous and preternatural head no pulsation could be felt in the arteries of the temples; but the superficial veins were very evident. One of the eyes had been hurt by the fire, upon which the midwife, in her first alarm, threw the child: the other moved readily; but the iris was not affected by the approach of any thing to it. The external ears of this head were very imperfect; the tongue adhered to the lower jaw, except for about half an inch at the lip, which was loose; the jaw was capable of motion, but there were no teeth. The child was shown about the streets of Calcutta for a curiosity; but was rendered unhealthy by confinement, and died at last of a bite of the *cobra de capello*. It was dug up by the East India Company's agent for salt at Tumlock, and the skull is now in the museum of Mr Hunter.

Among the monstrous productions of the animal kingdom, we may rank those individuals which ought only to possess one sex, but in which we observe the union or the appearance of two. See the articles ANDROGYNES and HERMAPHRODITE.

M. Fabri arranges mutilations of the members, distortions, gibbosites, tumors, divisions of the lips or of the palate, compressions of the cranium, and many other deformities of this kind, in the class of *morbific* monstruosities. In that which he calls *connatural* (*connaturelle*) monstruosities, are placed the plurality, transposition, and insertion of the parts. To explain these facts, a great many writers have had recourse to the effect of the imagination of pregnant women.—The causes of the first class of monstruosities are discussed by M. Fabri, who observes, that some of them are *internal* with regard to the mother, and others *external*. By an *internal cause* he here means all those depravations or morbific principles which can affect the fluids, and which vitiate the form and structure of the solids; in particular the uterus, in which such depravations have often been found to occur. To these he adds violent affections of the mind, spasmodic contractions, hysteric convulsions, and the many inconveniences of this kind to which women are extremely subject. External causes comprehend every thing which can act externally upon the fœtus contained in the uterus, such as the pressure of the clothes; and in short every thing which prevents the free dilatation of the belly in women that are pregnant, violent motions, falls, blows, and all accidents of this kind. These external causes, and especially the first, compress the fœtus in the womb, and oblige it to remain in a very confined situation. This according to the observation of Hippocrates, produces those embryos which are born with some entire part wounded. M. Fabri maintains, that all deformities of the fœtus proceed from some mechanical and accidental causes. Monster.

The name of *monsters* is likewise given to animals enormous for bulk; such as the elephant among terrestrial quadrupeds, and the shark and the whale among sea animals; to other animals remarkable for fierceness and cruelty; and to animals of an extraordinary species, which, we are told, arises from the copulation of one animal with another of a different genus. According to the report of travellers, Africa abounds with monsters of this kind; and accounts of the East are full of descriptions of sea monsters, which, however, are seldom to be seen, such as *sea men*, *mermaids*, *&c.*

Monsters are more common and more extraordinary in the vegetable than in the animal kingdom, because the different juices are more easily deranged and confounded together. Leaves are often seen, from the internal parts of which other leaves spring forth, and it is not uncommon to see flowers of the ranunculus from the middle of which issues a stalk bearing another flower. M. Bonnet informs us, that in certain warm and rainy years he has frequently met with monsters of this kind in rose trees. This observer saw a rose, from the centre of which issued a square stalk of a whitish colour, tender, and without prickles, which at its top bore two flower buds opposite to each other, and totally destitute of a calyx; a little above the buds issued a petal of a very irregular shape. Upon the prickly stalk which supported the rose, a leaf was observed which had the shape of a trefoil, together with a broad flat pedicle. In the memoirs of the Academy of Sciences for 1707, p. 448, mention is made of a rose from the centre of the leaves of which issued a rose branch two or three inches long, and furnished with

Monster || Montague.

with leaves. See the same Memoirs for 1749, p. 44. and for 1724, p. 20. In the Mémoirs for 1775, a very singular instance is mentioned of a monstruosity observed by M. Duhamel, in an apple-tree ingrafted with clay. At the place of the insertion, there appeared a bud which produced a stalk and some leaves; the stalk and the pedicle of the leaves were of a pulpy substance, and had the most perfect resemblance both in taste and smell to the pulp of a green apple. An extraordinary *chamæmelum* is mentioned in the *Acta Helvetica*. M. Bonnet, in his *Recherches sur l'usage des feuilles*, mentions likewise some monstrous productions which have been found in fruits with kernels, analogous in their nature to those which occur in the flowers of the ranunculus and of the rose tree. He has seen a pear, from the eye of which issued a tuft of 13 or 14 leaves, very well shaped, and many of them of the natural size. He has seen another pear which gave rise to a ligneous and knotty stalk, on which grew another pear somewhat larger than the first.—The stalk had probably flourished, and the fruit had formed. The *lilium album polyanthos*, observed some years ago at Breslaw, which bore on its top a bundle of flowers, consisting of 102 lilies all of the common shape, is well known. M. Reynier has mentioned some individuals monstrous with respect to the flower, in the *Journal de Physique et d'Histoire Naturelle*, for November 1785. He has likewise mentioned a monstrous tulip which is seen in the gardens of some amateurs; juniper berries with horns; a balsamine with three spurs, &c.

These vegetable productions which are so extraordinary, and so contrary to the common course of things, do nevertheless present deviations subject to particular laws, and reducible to certain principles, by distinguishing such as are perpetuated either by seed or by transplanting, from those which seem to be only accidental. Monstruosities which are perpetuated exist in the original organization of the seed of the plant, such as marked or curled leaves, &c. The word *monster* is more properly applied to those irregularities in plants, which arise from frequent transplantation, and from a particular culture, such as double flowers, &c.: but those monstruosities which are not perpetuated, and which arise from accidental and transient causes deranging the primitive organization of the plant when it comes to be unfolded, as is the effect of diseases, of heat or cold, of a superfluity or scarcity of juices, of a depravation of the vessels contributing to nutrition, of the sting of insects, of contusions and natural grafts, retain also the name of *monsters*. Of this kind are knobs or swellings, stunting, gall nuts, certain streaks, and other similar defects.

MONT-BLANC. See *Mont-Blanc*.

MONTAGUE, Lady Mary Wortley, accompanied her husband who was sent on an embassy to Constantinople in the beginning of the 18th century. On her return she introduced the practice of inoculation into England, and thence acquired great celebrity. She cultivated the belles lettres; and at one period of her life she was the friend of Pope, and at another his enemy. While they were at enmity with each other, Lady Mary Montague embraced every opportunity of defaming the poet, who well knew how to take revenge. Both of them carried their animosity to so great a height, that they became the subject of public conversation. After a long life, full of singular and romantic adventures, she died about the year 1760. From her we have *Letters*, written during her travels from the year 1716 to the year 1718. They have been translated into French, and published at Rotterdam 1764, and at Paris 1783, one vol. 12mo. They are composed in a lively, interesting, and agreeable style, and contain many curious facts relating to the manners and government of the Turks, which are nowhere else to be found. The Baron de Tott, who lived many years at Constantinople, attacked them with great severity; but they have been defended with equal zeal by M. Guis of Marseilles, who has published a valuable work on Turkey. It need not appear extraordinary, that persons who have visited the same country should not see things in the same light. How few travellers agree in their accounts of the same objects, which they nevertheless pretend to have seen and to have examined with attention.

Montague.

Montague, *Edward Wortley*, son of the former, passed through such variegated scenes, that a bare recital of them would savour of the marvellous. From Westminster school, where he was placed for education, he ran away three several times. He exchanged clothes with a chimney-sweeper, and he followed for some time that sooty occupation. He next joined himself to a fisherman, and cried flounders in Rotherhithe. He then sailed as a cabin boy to Spain; where he had no sooner arrived, than he ran away from the vessel, and hired himself to a driver of mules. After thus vagabondizing it for some time, he was discovered by the consul, who returned him to his friends in England. They received him with a joy equal to that of the father of the prodigal son in the gospel. A private tutor was employed to recover those rudiments of learning which a life of dissipation, of blackguardism, and of vulgarity, might have obliterated. Wortley was sent to the West Indies, where he remained some time; then returned to England, acted according to the dignity of his birth, was chosen a member, and served in two successive parliaments. His expences exceeding his income, he became involved in debt, quitted his native country, and commenced that wandering traveller he continued to the time of his death. Having visited most of the eastern countries, he contracted a partiality for their manners. He drank little wine, a great deal of coffee; wore a long beard; smoked much: and, even whilst at Venice, he was habited in the eastern style. He sat cross-legged in the Turkish fashion through choice. With the Hebrew, the Arabic, the Chaldaic, and the Persian languages, he was as well acquainted as with his native tongue. He published several pieces. One on the "Rise and Fall of the Roman Empire." Another an exploration of "The Causes of Earthquakes." As this gentleman was remarkable for the uncommon incidents which attended his life, the close of that life was no less marked with singularity. He had been early married to a woman who aspired to no higher a character than that of an industrious washerwoman. As the marriage was solemnized in a frolic, Wortley never deemed her sufficiently the wife of his bosom to cohabit with her. She was allowed a maintenance. She lived contented, and was too submissive to be

Montague || Montanists.

troublesome on account of the conjugal rites. Mr Montague, on the other hand, was a perfect patriarch in his manners. He had wives of almost every nation. When he was with Ali Bey in Egypt, he had his household of Egyptian females, each striving who should be the happy she who could gain the greatest ascendency over this Anglo-Eastern bashaw. At Constantinople, the Grecian women had charms to captivate this unsettled wanderer. In Spain a Spanish brunette, in Italy the olive-complexioned female, were solicited to partake the honours of the bridal bed. It may be asked what became of this group of wives? Mr Montague was continually shifting the place, and consequently varying the scene. Did he travel with his wives as the patriarch did with their flocks and herds? No such thing. Wortley, considering his wives as bad travelling companions, generally left them behind him. It happened, however, that news reached his ears of the death of the original Mrs Montague the washerwoman. Wortley had no issue by her; and without issue male, a very large estate would revert to the second son of Lord Bute. Wortley owing the family no obligations, was determined, if possible, to defeat their expectations. He resolved to return to England and marry. He acquainted a friend with his intentions; and he commissioned that friend to advertise for any young decent woman who might be in a pregnant state. Several ladies answered it. One out of the number was selected, as being the most eligible object. She waited with eagerness for the arrival of her expected bridegroom; but, behold, whilst he was on his journey, death very impertinently arrested him in his career.

Montague Island, one of the Hebrides, in the South sea near Sandwich island. E. Long. 168. 37. S. Lat. 17. 26.

MONTAIGNE, Michel de, a French gentleman, was born in Perigord in 1533. His father educated him with great care, and made him learn Latin as other children learn their mother tongue. His tutors were Nicholas Gronchi, who wrote *De Comitiis Romanorum*; William Guerenti, who wrote on Aristotle; George Buchanan; and M. Anthony Muret. He was also taught Greek by way of recreation; and because some think that starting children out of their sleep spoils their understanding, he was awakened every morning with the sound of music. He was counsellor for a while in the parliament of Bourdeaux; afterwards made mayor of Bourdeaux. He published his *Essays*, so much known in the world, in 1580. Montaigne had a great deal of wit and subtlety, but no small share of conceit and vanity. The learned and ingenious are much divided in their opinion about his works. He died in 1592.

MONTALCINO, a small populous town of Italy in Tuscany, and in the territory of Sienna, with a bishop's see. It is seated on a mountain, 17 miles south-east of Sienna, and 44 south-east of Florence. E. Long. 11. 30. N. Lat. 43. 7.

MONTALTO, an episcopal town of Italy, in the Marca of Ancona; seated on the river Monacio, 10 miles north of Ascoli, and 45 south of Ancona. E. Long. 13. 30. N. Lat. 42. 54.

MONTANISTS, Christian heretics, who sprang up about the year 171, in the reign of the emperor Marcus Aurelius. They were so called from their leader, the heresiarch Montanus, a Phrygian by birth; whence they are sometimes styled *Phrygians* and *Cataphrygians*. Montanists || Montecchio.

Montanus, it is said, embraced Christianity in hopes of rising to the dignities of the church. He pretended to inspiration; and gave out, that the Holy Ghost had instructed him in several points, which had not been revealed to the apostles. Priscilla and Maximilla, two enthusiastic women of Phrygia, presently became his disciples; and in a short time he had a great number of followers. The bishops of Asia being assembled together, condemned his prophecies, and excommunicated those who dispersed them.

The Montanists, finding themselves exposed to the censure of the whole church, formed a schism, and set up a distinct society under the direction of those who called themselves *prophets*. Montanus, in conjunction with Priscilla and Maximilla, was at the head of the sect.

These sectaries made no alteration in the creed. They only held that the Holy Spirit made Montanus his organ for delivering a more perfect form of discipline than what was delivered by the apostles. They refused communion for ever to those who were guilty of notorious crimes, and believed that the bishops had no authority to reconcile them. They held it unlawful to fly in time of persecution. They condemned second marriages, allowed the dissolution of marriage, and observed three lents.

The Montanists became separated into two branches, one of which were the disciples of Proclus and the other of Æschines. The latter are charged with following the heterodoxy of Praxes and Sabellius concerning the Trinity.

MONTARGIS, a considerable town of France, in the department of Loiret, situated on the river Long, at the junction of the two canals which connect the Seine and the Loire. It is 62 miles south of Paris, has some manufactories of paper and woollen, and is a place of considerable trade. E. Long. 2. 36. N. Lat. 48. 1.

MONTAUBAN, a considerable town of France, in the department of Lot, seated on the river Tarne, 20 miles north of Toulouse. E. Long. 1. 27. N. Lat. 43. 56.

MONTBAZON, a town of France, in the department of Indre and Loire, 135 miles south-west of Paris. E. Long. 0. 45. N. Lat. 47. 17.

MONTBELLIARD, a strong town of France, in the department of Haut Rhine, seated near the river Douhs, 45 miles north-east of Bezançon. Its population in 1800 was 4000. E. Long. 6. 50. N. Lat. 47. 31.

MONTBLANC, a town of Spain in the province of Catalonia, 15 miles north of Tarragon. E. Long. 1. 5. N. Lat. 41. 20.

MONTBRISON, a considerable town of France, in the department of Loire, seated on the river Veziza, 250 miles south by east of Paris. It contained 4703 inhabitants in 1800. E. Long. 4. 27. N. Lat. 45. 32.

MONTECCHIO, a considerable town of Italy, in the duchy of Reggio, 10 miles south-east of Parma, and eight north-west of Reggio. E. Long. 15. 54. N. Lat. 38. 8.

MONTE-Falco,

Monte-Falco || Montesquieu.

MONTE-FALCO, a town of Italy, in the territory of the Church and duchy of Spoletto; seated on a mountain near the river Clitunno, 12 miles west of Spoletto. E. Long. 12. 40. N. Lat. 42. 58.

Monte-Falcone, a town of Italy, in Friuli, with a castle, near the river Ponzano, 12 miles north-west of Trieste. It is in the Lombardo-Venetian territories of Austria. E. Long. 13. 20. N. Lat. 45. 50.

Monte-Fiascone, a small but populous town of Italy, in the territory of the Church, with a bishop's see; seated on a mountain, near the lake Bolsena, in a country abounding with excellent wine, 12 miles south-west of Orvieto, and 45 north-west of Rome. E. Long. 12. 4. N. Lat. 42. 26.

Monte-Marano, a populous town of Italy, in the kingdom of Naples, and in the Farther Principato; seated on the river Calore, 18 miles south of Benevento. E. Long. 15. 0. N. Lat. 40. 48.

Monte-Mor-o-novo, or *Monte-major-el-novo*, a considerable town of Portugal, on the road from Lisbon to Badajoz. W. Long. 9. 35. N. Lat. 38. 42.

Monte-Mor-o-velho, or *Monte-major-el-velho*, a town of Portugal in the province of Beira, with a very large castle, seated in a fertile country, 10 miles south-west of Coimbra, and 83 north of Lisbon. W. Long. 8. 9. N. Lat. 40. 5.

Monte-Peloso, an episcopal town of Italy, in the kingdom of Naples, and in the Basilicata; seated on a mountain near the river Basiento, 14 miles east of Cirenza. E. Long. 16. 28. N. Lat. 40. 46.

Monte-Pulsiano, a town of Italy, in Tuscany, with a bishop's see; seated on a high mountain, near the river Chiana, in a country noted for excellent wine, 25 miles south-east of Sienna, and 50 south by east of Florence. E. Long. 11. 49. N. Lat. 43. 10.

Monte-Sancto, formerly called *Mount Athos*, a mountain of Turkey in Europe, on the gulf of Contessa. It is called Monte-Saneto, or the Holy Mount, because there are 22 monasteries thereon, in which are 4000 monks, who never suffer a woman to come near them. It is 17 miles south of Salonichi. E. Long. 24. 9. N. Lat. 40. 10.

Monte-Verde, a town of Italy, in the kingdom of Naples, and in the Farther Principato, with a bishop's see: 60 miles east of Naples. E. Long. 15. 42. N. Lat. 40. 51.

MONTEGO BAY, a flourishing town on the north side of Jamaica. It has a very considerable commerce; 150 vessels clear out annually. The harbour is capacious; but exposed to north winds, which at certain times in the year blow with great violence. In June 1795, a fire consumed an immense quantity of stores, and great part of the town. W. Long. 77. 50. N. Lat. 18. 29.

MONTESA, a very strong town of Spain, in the kingdom of Valencia. It is the seat of an order of knighthood of the same name; and is five miles from Xativa. W. Long. 0. 30. N. Lat. 39. 0.

MONTESQUIEU, CHARLES DE SECONDAT, BARON, a most illustrious Frenchman, descended from an ancient and noble family of Guienne, was born at the castle of La Brede, near Bourdeaux, in 1689. The greatest care was taken of his education; and at the age of 20 he had actually prepared materials for his Spirit of Laws, by well digested extracts from those immense volumes of civil law which he had studied, not barely as a civilian, but as a philosopher. He became a counsellor of the parliament of Bourdeaux in 1714, and was received president à mortier two years after. In 1721 he published his Persian Letters; in which, under the screen of Oriental manners, he satirized those of France, and treated of several important subjects by delicate transient glances: he did not avow this publication; but was no sooner pointed out as the author, than zeal without knowledge, and envy under the mask of it, united at once against the Persian Letters. He was received into the French academy in 1728; and having previously quitted his civil employments, he entirely devoted himself to his genius, and was no longer a magistrate, but a man of letters. Having thus set himself at liberty, he travelled through Germany, Italy, Switzerland, Holland, and England, in which last country he resided three years, and contracted intimacies with the greatest men then alive; for Locke and Newton were dead. The result of his observations was, "that Germany was fit to travel in, Italy to sojourn in, England to think in, and France to live in." On his return he retired for two years to his estate at La Brede, where he finished his work On the Causes of the Grandeur and Declension of the Romans; which appeared in 1734. The reputation acquired by this last work only cleared the way for his greater undertaking, the Spirit of Laws, which was printed at Geneva in 2 vols. 4to, 1750. This was immediately attacked by the adversaries of his Persian Letters, in a multitude of anonymous pamphlets; containing all the reproaches to which a liberal mind is exposed from craft and ignorance, M. Montesquieu drew up a defence of this work; which for truth, moderation, and delicacy of ridicule, may be regarded as a model in its way. This great man was peaceably enjoying that fulness of esteem which his great merits had procured him, when he fell sick at Paris, and died on the 10th of February 1755.—The following character of this great man is drawn by Lord Chesterfield. "His virtues did honour to human nature, his writings justice. A friend to mankind, he asserted their undoubted and unalienable rights with freedom, even in his own country; whose prejudices in matters of religion and government he had long lamented, and endeavoured, not without some success, to remove. He well knew, and justly admired, the happy constitution of this country, where fixed and known laws equally restrain monarchy from tyranny, and liberty from licentiousness. His works will illustrate his name, and survive him, as long as right reason, moral obligation, and the true spirit of laws, shall be understood, respected, and maintained." As to his personal qualities, we are told by his eulogist, M. d'Alembert, that "he was of a sweet, gay, and even temper. His conversation was spirited, agreeable, and instructive. Nobody told a story in a more lively manner, or with more grace and less affectation. He had frequent absence of mind; but always awaked from it by some unexpected stroke that re-animated the languishing conversation. Though he lived with the great, he retired whenever he could to his estate in the country, and there met his books, his philosophy, and his repose. Surrounded at his leisure hours with peasants, after having studied man in the commerce of the world, he studied them in those simple

Montesquieu.

Montesquieu ‖ Montezuma.

simple people solely instructed by nature. With them he cheerfully conversed; he endeavoured, like Socrates, to find out their genius, and appeared as happy with them as in the most brilliant assemblies; especially when he reconciled their differences, and by his beneficence relieved them from their distresses."

Besides the works already mentioned, M. Montesquieu wrote several small pieces, as the Temple of Gnidus, Lysimachus, and an Essay upon Taste, which is left unfinished. His works have been collected since his death, and printed at Paris in a splendid edition, in quarto. They have likewise all of them been translated into English.

MONTEZUMA, or MOCTEÇUMA, was emperor or king of Mexico when Cortez invaded that country in 1518, invited thither, as he pretended, by the inhabitants, whose children Montezuma, in the blindness of his superstition, had sacrificed to his idols. The warlike animals on which the Spanish officers were mounted, the artificial thunder with which they were armed, the wooden castles on which they had crossed the ocean, the armour with which they were covered, the victories which they gained wherever they went; all these circumstances, added to that foolish disposition to wonder which always characterizes a simple people, so operated upon the minds of the Mexicans, that when Cortez arrived at the city of Mexico, he was received by Montezuma as his master, and by the inhabitants as a god. At first they fell down in the streets when a Spanish valet passed by; but by degrees the court of Montezuma grew familiar with the strangers, and ventured to treat them as men. Montezuma, unable to expel them by force, endeavoured to inspire them with confidence at Mexico by expressions of friendship, while he employed secret means to weaken their power in other quarters. With this view, one of his generals, who had private orders to that purpose, attacked a party of the Spaniards who were stationed at Vera Cruz; and, although his troops were unsuccessful, yet three or four of the Spaniards were killed. The head of one of them was carried to Montezuma. In consequence of this, Cortez did what has been reckoned one of the boldest political strokes that ever was performed. He ran to the palace, followed by fifty of his troops; and, by persuasion and threats, carried the emperor prisoner into the Spanish quarters. He afterwards obliged him to deliver up those who had attacked his troops at Vera Cruz: and, like a general who punishes a common soldier, he loaded Montezuma with chains. He next obliged him to acknowledge himself in public the vassal of Charles V.; and, in name of tribute for his homage, Cortez received 600,000 merks of pure gold. Montezuma soon afterwards fell a sacrifice to his submission to the Spaniards. He and Alvaro, the lieutenant of Cortez, were besieged in the palace by 200,000 Mexicans. The emperor proposed to show himself to his subjects, that he might persuade them to desist from the attack: but the Mexicans no longer considered him in any other light but as the slave of foreign conquerors. In the midst of his speech, he received a blow with a stone which wounded him mortally; and he expired soon after, A. D. 1520.—See CORTEZ. This unfortunate prince left two sons and three daughters, who embraced the Christian faith. The eldest received baptism, and obtained from Charles V. lands, revenues, and the title of count de Montezuma. He died in 1608; and his family is one of the most powerful in Spain.

Montezuma ‖ Montgeron

MONTFERRAT, a province of Italy, with the title of a duchy; bounded on the east by the duchy of Milan, and part of the territory of Genoa; on the north, by the Vercellese and Canavese; on the west, by Piedmont properly so called; and on the south by the territory of Genoa, from whence it is separated by the Apennine mountains. It contains 200 towns and castles; and is very fertile and well cultivated, abounding in corn, wine, oil, and silk. It belongs to the king of Sardinia, and Casal is the capital town.

MONTFORT, a town of France, in the department of Ille and Vilaine, seated on the river Mene, 12 miles from Rennes. W. Long. 1. 58. N. Lat. 48. 8.

MONTFORT, a handsome and strong town of the Netherlands, in the United Provinces, with an ancient castle; seated on the river Yssel, seven miles from Utrecht. E. Long. 5. 0. N. Lat. 52. 4.

MONTFORT, a town of Germany, in the circle of Suabia, on the confines of Tirol, 16 miles south of Lindow, and the lake of Constance. It is capital of a country of the same name, which has been almost all purchased by the house of Austria. E. Long. 9. 51. N. Lat. 47. 22.

MONTFORT-DE-LEMOS, an ancient town of Spain, in the kingdom of Galicia, with a magnificent castle, where the Comarca of Lemos resides. It is seated in a fertile country, 25 miles north-east of Orensa, and 55 south-east of Compostella. W. Long. 7. 9. N. Lat. 42. 28.

MONTFORT-L'AMULY, a town of France, in the department of Seine and Oise, 25 miles from Paris. E. Long. 2. 50. N. Lat. 48. 45.

MONTGATZ, a town of Lower Hungary, in the county of Pereczas, with a strong fortress. It is encompassed with a great morass, and art and nature have rendered it almost impregnable. It was defended by the princess Ragotsky, wife of Count Tekeli, when besieged by an army of the imperialists, who were obliged to raise the siege in 1688. E. Long. 21. 55. N. Lat. 46. 26.

MONTGERON, LOUIS-BASILE-CARRE DE, was born at Paris in 1686: his father was master of requests. He was scarcely 25 years of age when he purchased the place of counsellor in parliament, where by his wit and external qualifications he gained considerable reputation. Deeply engaged in all the vices which flow from irreligion, he was converted by an extraordinary circumstance. He went on the 7th of September 1731 to the tomb of Deacon Paris, with an intention to examine, with the rigour of the severest critic, the miracles which were reported to be performed there. But, according to his own account, he felt himself suddenly beat to the earth by innumerable flashes of light with which he was surrounded. His incredulity was converted into flaming zeal, and he became the apostle of the saint whom he formerly ridiculed. From that moment he devoted himself to the fanaticism of *convulsions*, with the same impetuosity of character with which he had run into the most shameful excesses. He had not long been the disciple of Jansenism when he suffered persecution. When the chamber of inquests was banished in 1732, he was sent into the mountains of Auvergne; which, instead

Montgeron || Montgomeryshire.

stead of cooling, tended rather to inflame his zeal. During his exile, he formed the plan of collecting the proofs of the miracles wrought at the tomb of the abbé Paris, and of composing what he called a *Demonstration* of them. On his return to Paris, he prepared to execute this plan; and on the 29th of July 1737, he actually presented to the king at Versailles a volume in quarto superbly bound. This work he accompanied with a speech, which is a mixture of zeal and argument in a tolerable style. In consequence of this work, which some consider as a masterpiece of eloquence, and others as a mass of absurdities, he was committed to the Bastile. After a few months confinement, he was sent to an abbey of Benedictine monks in the diocese of Avignon; whence he was in a short time carried to Viviers. He was afterwards confined in the citadel of Valence, where he died, A. D. 1574, aged 68. The work which he presented to the king was entitled *La verité des Miracles operées par l'intercession de M. Paris*, &c. &c.—The critics, even to this day, seem to be guided in their opinion concerning this book either by hatred or by enthusiasm. "It would be extremely rash (says the abbé de St Pierre, in the second volume of his *Annales*, p. 593.) to maintain with the Molinists, that no miraculous cure was ever performed at the tomb of the abbé Paris; and to say with the Jansenists, that these cures were performed by a supernatural power, would be the height of fanaticism. The truth is, (adds the same author), that no miracle appears ever to have been performed at this tomb except in the cure of the human body; in all other cases, there would have been the want of that imagination on which the whole miracle depended." Thus, although Montgeron ventured to compare these prodigies with the miracles of Jesus Christ and his apostles, yet we find no person raised from the dead, no multiplication of loaves, no command obeyed by the elements, and no blind or deaf restored to their sight or hearing. It belongs to the Author of nature alone, or to those who have derived power from him, to work such miracles as are recorded by the evangelists, or in the history of the apostles. Montgeron added a second and third volume on the same subject: he left also in manuscript a work which he composed in prison *contre les Incredules*. Religion, it must be confessed, has had much more powerful advocates. Fortunately Pascal and Bossuet are among the number; and it could well have wanted both Paris and Montgeron, whatever virtues they might possess in other respects.

MONTGOMERY, the capital of a county of the same name in North Wales, 158 miles from London, took its name from Roger de Montgomery earl of Shrewsbury, who built the castle. It is called by the Welsh *Tre Valdin*, that is, Baldwin's town; having been built by Baldwin, lieutenant of the marches of Wales, in the reign of William I. The Welsh, after having put the garrison to the sword, demolished it in 1095; but Henry III. rebuilt it, and granted it the privileges of a free borough, with other liberties. It is a tolerably well built town, in a healthful situation and fertile soil, with 932 inhabitants in 1811.

MONTGOMERYSHIRE, a county of North Wales, 40 miles in length and 37 in breadth; bounded on the north by Merionethshire and Denbighshire, on the north-east and east by Shropshire, on the south by Radnorshire and Cardiganshire, and on the west by the last-mentioned county and part of Merionethshire. It is divided into six hundreds; has five market towns and 47 parishes, and in 1811 contained 51,931 inhabitants. It lies in the three several dioceses of St Asaph, Bangor, and Hereford; but sends only two members to parliament, one for the county, and one for the town of Montgomery. The air is pleasant and salubrious; but this county, being extremely mountainous, is not very fertile, except in the valleys, which afford some corn and plenty of pasture, but the south, south-east, and north-east parts, being more level, are extremely fruitful, especially a pleasant vale, watered by the Severn.

Montgomeryshire, Month

MONTH, the twelfth part of a year. See CHRONOLOGY, N° 17.

MONTH, in its proper acceptation, is that space of time which the moon takes up in passing from any certain point to the same again, which is called a *periodical month*; or it is the space of time between two conjunctions of the moon with the sun, which is called a *synodical month*. That space of time which the sun takes up in passing through one sign or 12th part of the zodiac, is also called (but improperly) a *month*. So that there are two sorts of months; *lunar*, which are measured by the moon; and *solar*, which are measured by the sun. The lunar periodical month consists of 27 days 7 hours 43 minutes 5 seconds: The lunar synodical month is 29 days 12 hours 44 minutes 3 seconds and 11 thirds. A solar month contains, upon a mean calculation, 30 days 10 hours 29 minutes 5 seconds.

The Jews, Greeks, and Romans, made use of lunar synodical months; but, to avoid fractions, they consisted alternately of 29 and 30 days. The former, the Romans called *cavi*, and the Greeks χοιλοι; the latter were termed *pleni* and πληρεις.

1. The Hebrew months were ranged differently in their sacred and in their civil year.

Order of the Sacred Year.

1 *Nisan*	Answering to our	March.
2 *Jair*		April.
3 *Sivan*		May.
4 *Thammuz*		June.
5 *Ab*		July.
6 *Elul*		August.
7 *Tisri*		September.
8 *Marschevan*		October.
9 *Caslen*		November
10 *Thebet*		December.
11 *Sebat*		January.
12 *Adar*		February.

Order of the Civil Year.

1 *Tisri*	Answering to our	September.
2 *Marscheran*		October.
3 *Casleu*		November.
4 *Thebet*		December.
5 *Sebat*		January.
6 *Adar*		February.
7 *Nisan*		March.
8 *Jair*		April.
9 *Sivan*		May.
10 *Thammuz*		June.
11 *Ab*		July.
12 *Elul*		August.

Month. These months being lunar cannot exactly answer to our solar months; but every Jewish month must be conceived to answer to two of ours, and partake of both. As these 12 lunar months consisted only of 354 days, the Jews, in order to bring it nearer to the true year, took care every three years to intercalate a 13th month into the number, which they called *Ve-adar*, or the second Adar. The new moon was always the beginning of the month; and it is said the Jews had people posted on elevated places, to give notice to the Sanhedrim as soon as she made her appearance: After this, proclamation was made by sound of trumpet, and "the feast of the new moon, the feast of the new moon," resounded amongst the people.

The ancient Hebrew months were of 30 days each, excepting the last, which consisted of 35; so that the year contained 365 days, with an intercalary month at the end of 120 years, which, by absorbing the odd hours which remained at the conclusion of each year, brought it back nearly to its proper place. This regulation of the year was borrowed from the Egyptians.

2. The months of the Athenian year, as we have before observed, consisted alternately of 29 and 30 days. The first month, according to Meton's reformation of the kalendar, began with the first new moon after the the summer solstice, and was called *hecatombæon*, answering to the latter half of June, and the former half of July. The order of the months, with the number of days in each, are as follow:

1 *Hecatombæon*,	30	7 *Posidion*,	30
2 *Metageitnion*,	29	8 *Gamelion*,	29
3 *Boedromion*,	30	9 *Elaphebolion*,	30
4 *Mæmacterion*,	29	10 *Munichion*,	29
5 *Pancpsion*,	30	11 *Thargelion*,	30
6 *Anthesterion*,	29	12 *Scirrophorion*,	29

Each month was divided into three decades of days called δεχημερα. The first was called Μηνος αρχομενυ or ισαμενυ, or the decade of the beginning of the month; the second was Μηνος μεσυνλος or the decade of the middle; and the third was Μηνος φθινονλος, παυομενυ or ληγονλος, the decade of the expiring month.

The first day of the first decade was termed νεομηνια, because the first month began with the new moon; the second day was δευτερα ισαμενυ; the third τριτη ισαμενυ, &c. The first day of the second decade was πρωτη μεσυνλος, the second δευτερα μεσυνλος, &c.—the days of this decade were also called πρωτη επι δεκα, δευτερα επι δεκα, &c. The first day of the third decade was πρωτη επ' εικαδι; the second was δευτερα επ' εικαδι, &c. i. e. the first, second, &c. after 20, because the last decade began on the 20th day. This decade was also counted by inversion thus; φθινονλος δεκατη the 21st, φθινονλος ενατη the 22d, φθινονλος ογδοη the 23d, and so of the rest to the last day of the month, which was called ενη και νεα, the old and the new, because one part of that day belonged to the old and the other to the new moon; but after the time of Demetrius, the last day of the month was called from him Δημητριας; it sometimes was named τριακας.

The Grecian months, thus consisting of 29 and 30 days alternately, fell short of the solar year 11 days 6 hours. To remedy this defect, the cycle of four years, called τετραετηρις, was invented.—In this cycle, after the first two years, they added an intercalated month called εμβολιμος, consisting of 22 days; and again, after the expiration of two years more, they inserted another month of 23 days, the fourth part of a day having in the space of four years amounted to a whole day. See YEAR. Month.

3. The Roman year under Romulus consisted of 10 months only, and began with March, which contained 31 days; then followed April which had 30, May 31, June 30, *Quintilis* 31, *Sextilis* 30, September 30, October 31, November 30, December 30. These 10 months containing no more than 304 days, this account was in a short time found to be deficient. Numa Pompilius, therefore, took away one day from each of these six months, April, June, *Sextilis*, September, November, December; and to the six days thus obtained he added 51, which was the number that Romulus's year, in his opinion, wanted to make it perfect. Numa had now 57 days to dispose of; he therefore divided them, and constituted two other months, January and February; the former consisting of 29 and the latter of 28 days. The month of January, which he placed at the winter solstice, he made instead of March to begin the year. Thus Numa's year consisted of 355 days: but this being found 10 days 6 hours short of the solar year, he made use of the intercalation of 90 days at the expiration of eight years perpetually; which number, being made up of the 11 days and a quarter, kept the year pretty well to its place. The beginning of the year in Julius Cæsar's time had anticipated its true place 67 whole days: these he intercalated betwixt November and December: so that the year consisted, for this one time, of 15 months or 445 days. This reformation was called the *Julian correction*, and this year the *year of confusion*. At the end of 12 years, by the ignorance of priests, who did not understand intercalation, 12 days had been intercalated for nine. This was observed by Augustus Cæsar, and rectified, by ordering 12 years to pass without any intercalary days. The order and succession of months was the same as that of Numa: But January, March, May, *Quintilis*, *Sextilis*, October, and December, had each 31 days; April, June, September 30, and February, in common years, 28; but every fourth year or bissextile 29. This, with a very little difference, is the account observed at present. *Quintilis*, in compliment to Julius Cæsar was called *July*, because in this month he was born; and *Sextilis*, in honour of Augustus, was called August; both which names are still continued.—See YEAR.

Each month by the Romans was divided into *kalends*, *nones*, and *ides*, all of which were reckoned backwards. The *kalends* were the first day of the month. The *nones* fell on the seventh, and the *ides* on the 15th, of March, May, July, October—but in all other months the *nones* were on the fifth, and the *ides* on the 13th. For the more easy comprehension of the Roman manner of dating, according to this division of the months, here follows a table.

Month || Montpelier.

	March May July October	January August December	April June September November	February.
1	*Kalendæ*	*Kalendæ*	*Kalendæ*	*Kalendæ*
2	6	4	4	4
3	5	3	3	3
4	4	*Prid. Non.*	*Prid. Non.*	*Prid. Non.*
5	3	*Nonæ*	*Nonæ*	*Nonæ*
6	*Prid. Non.*	8	8	8
7	*Nonæ*	7	7	7
8	8	6	6	6
9	7	5	5	5
10	6	4	4	4
11	5	3	3	3
12	4	*Prid. Idus*	*Prid. Idus*	*Prid. Idus*
13	3	*Idus*	*Idus*	*Idus*
14	*Prid. Idus*	19	18	16
15	*Idus*	18	17	15
16	17	17	16	14
17	16	16	15	13
18	15	15	14	12
19	14	14	13	11
20	13	13	12	10
21	12	12	11	9
22	11	11	10	8
23	10	10	9	7
24	9	9	8	6
25	8	8	7	5
26	7	7	6	4
27	6	6	5	3
28	5	5	4	*Prid. Kal.*
29	4	4	3	
30	3	3	*Prid. Kal.*	
31	*Prid. Kal.*	*Prid. Kal.*		

N. B. Every leap year, February consisting of 29 days, the 24th and 25th of that month are written *sexto Kal. Mart.*; hence leap year is called *Bissextilis*.

MONTIA, a genus of plants belonging to the triandria class, and in the natural method ranking with those of which the order is doubtful. See BOTANY *Index*.

MONTINIA, a genus of plants belonging to the dicœcia class. See BOTANY *Index*.

MONTMEDI, a small but strong town of France, in the department of the Meuse, seated on the river Chire, which divides it into the upper and lower towns. It is 22 miles south-east of Sedan, 27 south-west of Luxemburg, and 135 north-east of Paris. E. Long. 5. 23. N. Lat. 49. 32.

MONTMORENCI, FRANÇOIS HENRY DE. See LUXEMBURG.

MONTMORENCY, a town of France, in the department of Seine and Oise, remarkable for the tombs of the dukes of this name. It is seated on a hill, near a large valley, fertile in fruits, especially excellent cherries. E. Long. 2. 24. N. Lat. 48. 59.

MONTPELIER, one of the finest towns of France, and the most considerable in the department of Herault, excepting Thoulouse, is situated in E. Long. 3. 58. N. Lat. 43. 37. This town has been long famous for its salubrious air, and on this account has been the frequent resort of invalids. But the climate, according to some travellers, is considerably changed, having at times constant rains for three months together, and often very thick fogs. Its situation, though on an eminence, never could be healthy; for between it and the Mediterranean (which is about two leagues distant) it is one continued marsh, covered with noxious vapours, which when the sea breeze sets in, blows directly on the town and the country adjacent; of the sad effects of which, its unhealthy inhabitants, with their meagre looks, are the most convincing proofs. Montpelier, Montreal.

This city stands upon a rising ground fronting the Mediterranean; on the other side is an agreeable plain, extending about the same distance towards the mountains of the Cevennes. It is reckoned well built, yet the streets are in general narrow and the houses dark. The city contained 33,913 inhabitants in 1800, many of whom are Protestants, and are sociable, gay, and good tempered. The trade of Montpelier is very extensive in wine, cordials, oil, verdigris, and saltpetre;—and the manufactures in silk and woollen goods are considerable. The markets are well supplied with fish, poultry, butcher's meat, and game, at reasonable rates. The wine of the country is strong and harsh: Burgundy is dear, and so is sweet wine of Frontignan, though made in the neighbourhood of Cette. Liquors of various sorts are compounded and distilled at Montpelier. The environs are extremely pleasant, having on one side La Place de Peyrou, which forms a fine terrace. From thence on a clear day, may be seen to the eastward the Alps, which form the frontiers of Italy; to the south-west, the Pyrenean mountains, which form those of Spain, both at about 50 leagues distant; and to the southward a most extensive view of the Mediterranean. Not far from thence is a noble aqueduct, with a double tier of arches; by this, water is brought from a mountain at three leagues distance, into two basons in a small elegant temple at the west end of the town. Here also is a royal garden, where on certain days public lectures were formerly held on botany. On the other side of the town is the esplanade, a beautiful walk, bordered on each side by olive trees, from whence there is a pleasing prospect of the sea and the country adjacent to the town. Previous to the revolution, Montpelier had an university, an academy of sciences, and it was the see of a bishop.

MONTREAL, an island of North America, in the river St Lawrence, ten leagues in length, and four leagues broad, and about 60 miles above Quebec. It was taken from the French by generals Amherst and Murray on the 8th of September 1760. The soil of the island is exceedingly rich and good, producing all kinds of European fruits and vegetables in great abundance, with variety of garden fruits. The south side is the most inhabited, and of course best cultivated; and besides the settlements, which are numerous, the island is adorned with villas, for the retirement of the more wealthy merchants during the summer season.

The town of MONTREAL, situated on this island, and formerly called *Ville Marie*, is the second place in Canada for extent, buildings, and strength; and besides possessing the advantage of a less rigorous climate, for delightfulness of situation is infinitely preferable to Quebec. It stands on the side of a hill, sloping to the south, with many agreeable villas upon it, which with the

Montreal || Montserrat.

the island of St Helen, and the river (which is here about two miles broad), form a most charming landscape. It was formerly enclosed with walls, to protect it from the Indians, but these were levelled some years ago. Though the city is not very broad from north to south, it covers a great length of ground from east to west, and is fully as large and populous as Quebec. The streets are regular, forming an oblong square; the houses well built, and in particular the public edifices, which far exceed those of the capital in beauty and commodiousness; the residence of the knights hospitallers being extremely magnificent.—There are several gardens, in which, however, the proprietors have consulted use more than elegance, particularly those of the Sisters of the Congregation, the Nunnery Hospital, the Recollets, Jesuit Seminary, and Governor. The number of inhabitants in 1807 was about 10,000. The gardens produce peaches, apricots, plums, currants, &c. By the situation of the place, the inhabitants are well supplied with all kinds of river fish, some of which are unknown to Europeans. They have likewise plenty of black cattle, horses, hogs, and poultry. The neighbouring shores supply them with a great variety of game in the different seasons; and the island abounds with springs of good water and numerous rivulets. The trade in furs is considerable, and vessels of 200 tons can come up to the town. See CANADA, SUPPLEMENT.

MONTREAL, a town of Spain, in the kingdom of Arragon, with a castle, seated on the river Xiloca, 25 miles north-west of Terville, and 40 south-east of Calataud. W. Long. 1. 2. N. Lat. 41. 9.

MONTREAL, a town of Sicily, and in the valley of Mazara, with an archbishop's see; seated on a rivulet, five miles west of Palermo, and 50 north-east of Mazara. E. Long. 13. 31. N. Lat. 38. 14.

MONTREAL, or MOUNT ROYAL, a fortress of Germany, in the circle of the Lower Rhine, in the Prussian territories, seated on the river Moselle, 22 miles north-east of Triers. E. Long. 7. 6. N. Lat. 49. 59.

MONTROSE, a handsome town of North Britain, in the shire of Angus, situated at the mouth of the river Esk, on the German ocean, 46 miles north-east of Edinburgh. The houses are neat, and many of them in the modern taste. The most remarkable public buildings are, the town-house, the church, and an elegant episcopal chapel.—Montrose is a royal burgh, and a dukedom in the family of Graham. It stands between two rivers, the south and north Esks, over the latter of which there is a handsome stone bridge, and over the former there is one of wood. The salmon fisheries on these rivers are very extensive, and form a considerable branch of commerce. The harbour is a fine semicircular bason defended by a handsome stone pier. A great number of trading vessels belong to this port. The population of Montrose in 1811 amounted to 8955. W. Long. 2. 32. N. Lat. 36. 40.

MONTROSE, *Marquis of.* See GRAHAM; and BRITAIN, N° 137, 138, 143, 265.

MONTSERRAT, a mountain of Spain, in Catalonia, one of the most singular in the world for situation, shape, and composition. It stands single, towering over a hilly country like a pile of grotto work or Gothic spires; and its height so great, that to a beholder on the top the neighbouring mountains appear to be sunk to a level with the plain. It is composed of steep rocks, which at a distance seem indented; whence it is said to have received the name *Montserrat* from the Latin word *serra*, a "saw." It is impossible to describe the beauty, richness, and variety, of the landscapes discovered from the most elevated point: but the extensiveness of the prospect may be conceived by the reader, upon being told that the islands of Minorca and Majorca, which are at the distance of 60 leagues, are discovered from this elevation. Montserrat.

Montserrat is particularly famous for the adoration that is paid to an image of the Virgin, which according to tradition was found in a cave in this mountain by some shepherds in the year 880. Over this image, Guthred earl of Barcelona caused a monastery and chapel to be erected; but after remaining in this receptacle upwards of 700 years, Philip II. and Philip III. built a magnificent church for its reception. Innumerable and astonishing miracles are ascribed to this holy image. The convent or monastery is situated in a nook of the mountain; it seems as if vast torrents of water, or some violent convulsion of nature, had split the eastern face of Montserrat, and formed in the cleft a sufficient platform to build the monastery upon. The river Llobregat roars at the bottom, and perpendicular walls of rock of prodigious height, rise from the water edge near half way up the mountain. Upon these masses of white stone rests the small piece of level ground which the monks inhabit. Close behind the abbey, and in some parts impending over it, huge cliffs shoot up in a semicircle to a stupendous elevation: their summits are split into sharp cones, pillars, pipes, and other odd shapes, blanched and bare; but the interstices are filled up with forests of evergreen and deciduous trees and plants. Fifteen hermitages are placed among the woods; nay, some of them on the very pinnacles of the rock, and in cavities hewn out of the loftiest of these pyramids.

The monastery is one of the 45 religious houses of the Spanish congregation of the order of St Benedict; their general chapter is held every fourth year at Valladolid, where the deputies choose abbots and other dignitaries for the ensuing quadrennium. In this monastery, they elect for abbot a Catalan and a Castilian alternately. Their possessions are great, consisting of nine villages lying to the south of the mountain; but the king has lately curtailed their income about 6000 livres a-year, by appropriating to his own use the best house in each village, some of which, with their tythes, are worth 200 dollars per annum. Their original foundation, in 866, gave them nothing but the mountain; and to donations and economy they owe the great increase of their landed property. They are bound to feed and harbour for three days all poor pilgrims that come up and pay their homage to the Virgin; and the allowance is a luncheon of bread in the morning, as much more, with broth at noon, and bread again at night. Sometimes, on particular festivals, 7000 persons arrive in one day; but people of condition pay a reasonable price for what they eat.—The number of professed monks, according to Mr Swinburne, is 76 (according to M. Bourgoanne 60); of lay brothers, 28; and of singing boys 25; besides physician, surgeon, and servants. The church is a gloomy edifice; and the gilding is much sullied with the

Montserrat.

the smoke of 85 lamps of silver, of various forms and sizes, that hang round the cornice of the sanctuary. Funds have been bequeathed by different devotees for furnishing them with oil. The choir above stairs is decorated with the life of Christ, in good wooden carving. A gallery runs on each side of the chancel, for the convenience of the monks. A large iron grate divides the church from the chapel of the Virgin, where the image stands in a niche over the altar, before which burn four tapers in large silver candlesticks, the present of the duke of Medina Celi. In the sacristy, and passages leading to it, are presses and cupboards full of relicks and ornaments of gold, silver, and precious stones; they point out, as the most remarkable, two crowns for the virgin and her son, of inestimable value; some large diamond rings; an excellent cameo of Medusa's head; the Roman emperors in alabaster; and the sword of St Ignatius. But as no offerings to this miraculous statue can be rejected or otherwise disposed of, the shelves are crowded with most whimsical *ex votos*, viz. silver legs, fingers, breasts, ear-rings, watches, two-wheeled chaises, boats, carts, and such like trumpery.

On different parts of the mountain, as already noticed, are a number of hermitages. Each of these solitary retreats, which at a distance seem destitute of every thing, has a chapel, a cell, a well in the rock, and a little garden. The inhabitant of one of them, which is dedicated to St Beneto, has the privilege of making an annual entertainment on a certain day; on which day all the other hermits are invited, when they receive the sacrament from the hands of the mountain vicar, and after divine service dine together. They meet also at this hermitage, on the days of the saints to which their several hermitages are dedicated, to say mass and commune with each other. But at other times they live in a very solitary and recluse manner, perform various penances, and adhere to very rigid rules of abstinence; nor do they ever eat flesh; nor are they allowed to keep within their walls either dog, cat, bird, or any living thing, lest their attention should be withdrawn from heavenly to earthly affections. Most of these hermits are said to be persons of fortune and family, disgusted with the world, who have retired thither to devote themselves to meditation, self-denial, and contrition.

MONTSERRAT, one of the Caribbee isles, belonging to Great Britain. It is a very small, but very pleasant island, so called by Columbus from its resemblance to the famous mountain near Barcelona in Catalonia. It lies in W. Long. 61. 0. N. Lat. 16. 50. having Antigua to the north-east, St Christopher's and Nevis to the north-west, and Guadaloupe lying south-south-east at the distance of about nine leagues. It is about nine miles in diameter, and is supposed to contain about 40,000 or 50,000 acres. The climate is warm, but less so than Antigua, and is esteemed very healthy. The surface is mountainous, but with pleasant, rich, and fertile valleys; the hills are covered with cedars and other fine trees. Here are all the animals as well as vegetables and fruits that are to be found in the other islands. The inhabitants raised formerly a considerable quantity of indigo. The produce now is chiefly cotton, rum, and sugar. There is no good harbour, but three tolerable roads, at Plymouth, Old Harbour, and Ker's Bay.

Monument || Moon.

MONUMENT, in *Architecture*, a building destined to preserve the memory, &c. of the person who raised it, or the person for whom it was raised; such are a mausoleum, a triumphal arch, a pyramid, &c.

MOOD, or MODE. See MODE.

Moods of Syllogism. See LOGIC, N° 85.

MOOD, or *Mode*, in *Grammar*, the different manner of conjugating verbs. See GRAMMAR.

MOON, (*Luna* ☽), in *Astronomy*, one of the heavenly bodies, usually ranked among the planets; but with more propriety accounted a satellite, or secondary planet.

Among the ancients, the moon was an object of prime regard.—By the *Hebrews* she was more regarded than the sun, and they were more inclined to worship her as a deity. The new moons, or first days of every month, were kept as festivals among them, which were celebrated with sound of trumpets, entertainments, and sacrifice. (See Numb. xviii. 11. x. 16. 1 Sam. xx. 5—18.). People were not obliged on these days to rest. The feasts of new moons were a miniature representation of the feast of trumpets, which was held on the first of the month Tisri, which was the beginning of the civil year. The Jews not being acquainted with the physical causes of eclipses, looked upon them, whether of sun or moon, as signs of the divine displeasure. The Grecians looked upon the moon as favourable to marriage; and the full moons, or the times of conjunction of sun and moon, were held the most lucky seasons for celebrating marriages; because they imagined the moon to have great influence over generation. The full moon was held favourable for any undertakings by the Spartans: And no motive could induce them to enter upon an expedition, march an army, or attack an enemy, till the full of the moon. The moon was supposed both by Greeks and Romans to preside over child-birth. The patricians at Rome wore a crescent on their shoes, to distinguish them from the other orders of men. This crescent was called *Lunula*. Some say it was of ivory, others that it was worked upon the shoe, and others that it was only a particular kind of fibula or buckle.

For the astronomical phenomena connected with the moon, see ASTRONOMY *Index*.

Harvest-Moon.—It is remarkable, that the moon, during the week in which she is full in harvest, rises sooner after sunsetting than she does in any other full moon week in the year. By doing so, she affords an immediate supply of light after sunset, which is very beneficial to the farmers for reaping and gathering in the fruits of the earth: and therefore they distinguish this full moon from all the others in the year, by calling it the *harvest-moon*.

Influence of the Moon on the Human Body.—The famous Dr Mead was a believer in the influence of the sun and *moon* on the *human body*, and published a book to this purpose, entitled *De Imperio Solis ac Lunæ in Corpore humano*: but this opinion has been exploded by most philosophers, as equally unreasonable in itself, and contrary to fact. As the most accurate and sensible barometer is not affected by the various positions of the moon, it is not thought likely that the human body should be affected by them. Several learned and ingenious men, however, still consider Dr Mead's doctrine as far from being unfounded.

MOON, *Influence of, on the Earth's Atmosphere.*—It has

Moon. has been the opinion of the vulgar in almost all ages and countries, that the changes which take place in the state of our atmosphere, or the changes of the weather, depend in a great measure on certain situations of the moon. This particular opinion is alluded to by Virgil (A), and is applied in the shepherd of Banbury's rules for judging of the weather (B). We have, under METEOROLOGY, N° 90 to 92, given the result of some observations on the connection between the changes of the moon and those of the weather.

It can scarcely be doubted that an opinion so generally received must be founded on something more than fancy or prejudice; and indeed the observations of several eminent meteorologists within the last thirty years have contributed materially to favour this opinion. Independent of actual observation, it appears reasonable to infer, that a body so large, and so near the earth, as the moon, whose gravitating influence on the earth's surface in producing the *flux and reflux of the sea*, cannot be altogether inactive with respect to the air, a fluid much more susceptible of changes than the sea.

We have already noticed (METEOROLOGY, N° 14.) the theory of Mr Luke Howard, on the moon's influence on the mercury of the barometer, and we are now to give a short account of what has been advanced on her general influence by the philosophers of the continent. Among these, Signior Toaldo may be said to have led the way.

From observations made at Padua, during fifty years, on the state of the weather that corresponded to certain changes of the moon, he found that these changes were always accompanied by good or bad weather; and he at length became enabled to foretel with some degree of certainty what would be the state of the atmosphere that should follow any situation of the moon. There are ten situations of the moon, which, according to Toaldo, are capable of producing a sensible effect on the earth's atmosphere. These are the *syzigies* * or new and full moon; the quadratures; the *apsides*, or apogee and perigee; the *lunistices*, or these points when the moon is nearest to our zenith and at the greatest distance from it; and the moon's *equinoxes*. There are three different relations of the moon's motion producing a corresponding number of revolutions, each having a certain duration, and each corresponding to some of the above ten situations, as it will be seen by the following table.

* See Astronomy, N° 90.

Revolutions.	Situations.
1. *Synodical*, in regard to the sun; continues 29 days 12 hours 44 minutes.	New moon. First quarter Full moon. Last quarter.
2. *Anomalistic*, in regard to the moon's course; continues 27 days 13 hours 43 minutes.	Apogeum. Perigeum.
3. *Periodical*, in regard to the moon's passing the equator; coutinues 27 days, 7 hours, 43 minutes.	Ascending equinoxes. Northern lunistices. Descending equinoxes. Southern lunistices.

Moon.

Sig. Toaldo has calculated a series of probabilities that a change of weather will take place on the approach of any one of these ten situations, and these he has expressed in a tabular form as follows,

That a change will take place at	New moon	is	6:1
	First quarter		5:2
	Full moon		5:2
	Last quarter		5:4
	Perigeum		7:1
	Apogeum		4:1
	Ascending equinox		13:4
	Northern lunistice		11:4
	Descending equinox		11:4
	Southern lunistice		3:1

In general, each of the ten situations changes the weather that prevailed under the preceding situation, and it seldom happens that a change of weather takes place without a corresponding change in the lunar situations. From the inequality of their revolutions, these situations are often combined, and by this union their effect in producing changes of the atmosphere is greatly increased, especially when a union takes place between the syzigies and apsides. Thus,

That a change will follow	New moon with perigee	is	33:1
	Ditto with apogee		7:1
	Full moon with perigee		10:1
	Ditto with apogee		8:1

These combined situations are generally accompanied or followed by storms and tempests, especially when they take place near the moon's passage over the equator. This is more particularly the case in the months of March and September, and we find that at the new and full moon in these months, the weather takes a certain character, by which it is distinguished for the succeeding three or six months. The same takes place at the solstices, especially at the winter solstice. The new moon does not always, however, produce a change of weather; and this want of effect is most likely to happen at those new moons which are most distant from the apsides.

Though Toaldo considers it as perfectly ascertained that each succeeding situation of the moon alters that state of the atmosphere which had been produced by the preceding situation; it must, however, be observed that some situations of the moon favour good and others bad weather. Thus the perigee, the new and full moon, the passage over the equator, and the northern lunistice are favourable to bad weather, while the apogee

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(A) ——"lunasque sequentes
Ordine respicies; nunquam te crastina fallet
Hora, neque insidiis noctis capiere serenæ.
Georg. I. 424.

(B) 1. Horns of the moon obscure—*Rain.*
2. When the moon is red—*Wind.*
3. On the fourth day of the new moon, if bright, with sharp horns—*No winds nor rain till the month be finished.*

Moon. gee, quadratures and southern lunistice, are more favourable to good weather.

The changes produced by the influence of the lunar situations, seldom take place on the exact days on which these situations happen, but either precede or follow them; and Toaldo has found that, in the six winter months, the changes of weather commonly precede the lunar situations, whereas in the six summer months they more commonly follow them.

There are certain days before and after new and full moon, which deserve particular attention in forming our judgments of the weather, especially the octants or the fourth day before new and full moon, as at these times the weather is inclined to change, and it may be pretty certainly predicted, that a change will follow at the next lunar situation. Virgil has particularly noticed this fourth day as a sure mark of the succeeding weather (c.) If the weather continues unchanged on the fourth, fifth, and sixth day of the moon, it proves that the lunar influence is at that time very weak, and we are to expect no change till the full moon, or perhaps till the next new moon.

Sig. Toaldo compared a diary which he had kept for many years of the state of the barometer with the ten situations of the moon, and from the comparison deduced the following conclusions, viz.

1. That at the time of the moon's apogee, the mercury rises higher by the sixth part of a line than at the perigee.

2. That at the time of the quadratures it is higher by the tenth of a line than at the time of the syzigies.

3. That it is higher by a fourth of a line at the southern than at the northern lunistice. This correspondence of the lunar situations with the ascent of the mercury in the barometer does not hold at the time of the moon's passage through her equinoctial points. The mercury is then higher, especially when she is passing in Libra; and as such situations of the moon generally indicate bad weather, this circumstance is not conformable to meteorological observations.

In this case Toaldo thinks that we must be guided in our judgment of the weather, rather by the moon than by the barometer.

The case is similar during the coincidence of the equinoctial points with the perigee, at which time the mercury is unusually high; but this coincidence is a sign of great regularity.

According to Toaldo, the rising and setting of the moon, as well as its superior and inferior passage of the meridian, all which situations he calls the moon's angles, may serve for foretelling rain. The seasons most exposed to rain, are the rising and setting of the moon; while its passage over the meridian is most favourable to good weather. It has ever been observed that during rainy days, the sky always clears a little while the moon is passing the meridian. An exception to this rule must, however, be made when the moon's angle does not coincide with that of the sun.

Bad years take place when the apsides of the moon fall in the four cardinal points of the zodiac. Their intervals, therefore, are as four to five, eight to nine, &c. or as the intervals of the passage of the apsides through the four cardinal points of the zodiac. Thus the year 1777 was, in general, a bad year; and in that year the apsides of the moon were in the equinoctial signs; and it is probable that the years in which the apsides fall in the signs Taurus, Leo, Virgo and Aquarius, will be good and moderate years, as the year 1776 really was; and in that year the apsides of the moon were in Taurus and Virgo. Moon

Every 18th year must be similar. We, however, cannot depend upon a return altogether the same, on account of the three different revolutions of the moon; and therefore it may happen, that the epoch of this extraordinary year may be retarded a year or perhaps two. Though approximations only are here given, this does not prevent their being useful to farmers, if they only pay attention to circumstances. Besides, various exceptions must be made for different parts of the earth; and it is difficult to determine these before-hand, as what regards this system is applicable to the whole globe; but when the result of the system has been improved by local observations, the conjectures for each country will be attended with more certainty.

The 54th year must have a greater similarity to the first than to all the rest; because, at this period, the situations of the moon, in regard to the sun and the earth, are again found in the same points.

The quantity of the rain which falls in nine successive years, is almost equal to that which falls in the next following nine. But this is not the case when we compare in like manner the quantity of rain which falls in six, eight, or ten years *.

* See *Phil. Mag.* vol. iii.

The observations of M. Lamarck, though they confirm the opinion of the moon's general influence on the atmosphere, do not agree with those of Toaldo, as to the situations of that luminary which correspond to the changes of the weather. He could not find that agreement between the syzigies and quadratures of the moon and a change of weather, which has been so much dwelt on by Toaldo; but he is of opinion, that we are to consider the *declination* of the moon as the principal cause of her influence on the atmosphere.

Lalande had conceived the idea that when the moon entered the northern hemisphere, or had *north declination*, the weather was most likely to be cold and dry, and that when she passed to the south of the equator, it was likely to be rainy. The observations of Lamarck, however, tend to establish the contrary opinion.

Lamarck considers the two following principles as established by his observations; viz.

1. *That it is in the elevation of the moon above, and her depression below the equator, that we are to search for those regularly varied effects which she produces on our atmosphere.*

2. *That the determinable circumstances, which conspire*

(c) Luna revertentes cum primum colligit ignes,
Si nigrum obscuro comprenderit aëra cornu;
Maximus agricolis pelagoque parabitur imber.
At, i virgineum suffuderit ore ruborem,
Ventus erit; vento semper rubet aurea Phœbe.
Sin ortu in quarto (namque is certissimus auctor)
Pura, neque obtusis per cœlum cornibus ibit;
Totus et ille dies, et qui nascentur ab illo
Exactum ad mensem, pluvia ventisque carebunt.
See Note (n). *Georg.* I. 427.

Moon. *spire to increase or diminish the moon's influence in her different declinations, are her apogees and perigees, her conjunctions with and oppositions to the sun; and lastly, the solar solstices and equinoxes.*

Considering that every lunar month, or every revolution of the moon in the zodiac, may be divided into two distinct portions, each containing about fourteen days, and each giving occasion to a particular atmospheric constitution, we may assume these as two circumstances of importance in meteorology, and we may call one the *boreal* or *northern* constitution, viz. that in which the moon passes through the six northern signs of the zodiac, and the other, the *austral* or *southern* constitution, viz. that in which she traverses the six southern signs.

Lamarck is convinced by observation, that in these climates, during a *boreal constitution*, there chiefly prevail southerly, south-westerly, and westerly winds, though sometimes, in the summer, the winds pass to the south-east. In general, during this constitution, the barometer exhibits only moderate elevations of the mercury; most commonly the season is rainy or moist, and the air loaded with clouds. And, lastly, it is particularly during this constitution that we observe the effects of storms and tempests, when the causes which occasion them become active.

On the contrary, during an austral constitution, the winds which chiefly predominate blow from the north and north-west, and in the summer north-east, and even easterly winds. In general during this constitution, the barometer exhibits considerable elevations in the column of mercury, at least if the wind is not very strong; the weather is then most usually clear, cold and dry, and in the summer it is seldom (we might almost say never) during this constitution that storms are formed.

These atmospheric constitutions are not, however, so permanently characterised as to render it easy to distinguish them at all times by the state of the atmosphere. The atmospheric air is a moveable fluid, and so easily displaced, that it is not surprising that in the temperate zones, where the influence of the heavenly bodies acts less strongly than between the tropics, from various causes, that counteract very often the regular influence of the moon, and tend to mask and even change its effects.

The perturbations which these variable causes produce on the regular effects of the influence of the moon on the atmosphere, occasion in fact many variations in the two atmospheric constitutions which we have been describing; and this is doubtless the reason why they have been hitherto disregarded. M. Lamarck positively asserts, that these perturbations, though frequent, and sometimes very considerable, do not prevent the character of each of these constitutions from being remarked in the greatest number of cases.

The probability that he finds, according to his observations, is estimated at five out of eight; that is to say, out of 48 atmospheric constitutions comprehended in the lunar year, he estimates there will be found at least 30 agreeing with the principles pointed out in his memoir; and he adds, that among the disturbing causes which modify the before-mentioned effects, several may be foreseen, and perhaps even appreciated as to their quantity of effect.

He considers what is here pointed out as a fact; as an order of things which any one may prove by observation *. Moon.

Lamarck has also endeavoured to ascertain what truth there may be in the periodical return of the variations of the atmosphere at the end of nineteen years; and he has found, by comparing meteorological observations, that this return is far from being so correct as is generally believed.

Astronomers also know well, that the cycle of nineteen years is not exact within an hour and a half; an error which amounts to a whole day in the course of 308 years †.

M. Cotte has also bestowed much attention on this subject of the moon's influence; but appears to think that our observations are not sufficiently numerous or accurate, to deduce any thing like a correct theory, and he is not disposed to go so far as M. Lamarck.

M. Cotte agrees in general with Mr Luke Howard's observations on the moon's influence. (See METEOROLOGY). He noted, during the space of 34 years and five months, from the 1st of January 1768, to the 22d of May 1802), the ascending and descending direction of the barometer in each of the syzigies and quarters of the moon which have occurred through that period of time. He states the total sum of the elevations and depressions of the mercury at each of the phases as follows.

For $34\frac{1}{2}$ Years.	New moon	1st Quar.	Full moon.	2d Quar.	
Sum of elevations	218	296	199	290	times.
——— depressions	281	229	279	106	
Differences	63	67	80	84	

These results, of nearly 35 years observations, confirm, as will be seen, the conclusions drawn by Mr Howard, both from his observations of one year at Plaistow, and those made for 10 years in the Royal Society's apartments.

It is to be remarked, 1st, That the four numbers which express the differences between the elevations and depressions are nearly in an exact proportion, since $63 : 67 :: 80 : 85\frac{5}{7}$.

2dly, That the two latter phases, viz. the full moon and last quarter, have more effect than the two first.

3dly, He examined what phases of the moon corresponded to the greatest and least height of the mercury for each month during ten years, and obtained the following results.

For 10 Years.	New Moon.	1st Quar.	Full Moon.	2d Quar.	
Greatest elevation occurred at	26	40	26	28	times.
Greatest depression occurred at	30	34	29	27	
Differences	4	6	3	1	

The science may be therefore said to have advanced one step farther on this occasion; and it is to be hoped that, by multiplying observations, and combining them in various ways to obtain their results, its progress may be still accelerated. The useful purposes which may be thereby answered in philosophy, agriculture, and medicine, may be properly urged to observers as the means

* See *Jour. de Phys.* vol. iii. an *Nichol. Jour.* 4to, vol. iv.

† *Phil. Mag.* vol. v.

of

Moon || Moore.

of supporting their ardour, and indemnifying them for those sarcasms and reflections which even some learned men have been pleased to bestow upon observations of this sort, together with their authors *. See METEOROLOGY, SUPPLEMENT.

* *Phil. Mag.* vol. xiii.

Moon-Eyes, among horses, when the weakness of the eye increases or decreases according to the course of the moon; so that in the wane of the moon his eyes are muddy and troubled, and at new moon they clear up. This observation is probably inaccurate.

Moon-stone, or *Adularia*. See ADULARIA, MINERALOGY *Index*.

Moon-Wort. See LUNARIA, BOTANY *Index*.

MOOR, in country affairs, denotes a tract of land, usually overrun with heath.

Moor-Cock, or *Gor-Cock*. See TETRAO, ORNITHOLOGY *Index*.

Moor Land, or *Moory Soil*, in *Agriculture*, is a black, light, and soft earth, very loose, and without any admixture of stones; and with very little clay or sand.

MOORE, or MORE, EDWARD, an ingenious writer, was bred a linen-draper, but quitted business to join the retinue of the Muses; and he certainly had a very happy and pleasing talent for poetry. In his Trial of Selim the Persian, he complimented Lord Lyttelton in an elegant kind of panegyric, couched under the appearance of accusation: and his Fables for the Female Sex, for easy versification, poignant satire, and striking morals, approach nearer to the manner of Gay than any other of the numerous imitations of that author. He wrote also three dramatic pieces; the Gamester, a tragedy; The Foundling, and Gil Blas, comedies. The success of these was not such as they merited, the first of them having met with a cold reception, for no other apparent reason but because it too nearly touched a favourite and fashionable vice; and the second having been condemned for its supposed resemblance to Sir Richard Steele's Conscious Lovers, but to which good judges have been inclined to give it greatly the preference. Mr Moore married a lady of the name of *Hamilton*, daughter to Mr Hamilton table-decker to the princesses, who had herself a very poetical turn, and has been said to have assisted him in the writing of his tragedy. One specimen of her poetry, however, was handed about before their marriage, and has since appeared in print in different collections of songs. It was addressed to a daughter of the famous Stephen Duck; and begins with the following stanza:

Would you think it, my Duck? (for the fault I must own),
Your Jenny at last is quite covetous grown:
Though millions if Fortune should lavishly pour,
I still would be wretched if I had not MORE.

And after half a dozen stanzas more, in which, with great ingenuity and delicacy, and yet in a manner that expresses a great affection, she has quibbled on our author's name, she concludes with the following lines:

You may wonder, my girl, who this dear one can be,
Whose merit can boast such a conquest as me:
But you shan't know his name, tho' I told you before,
It begins with an M, but I dare not say MORE.

In the year 1753, Mr Moore commenced a weekly miscellaneous paper, entitled, *The World, by Adam Fitz-Adam*, in which undertaking he was assisted by Lord Chesterfield with some Essays. This paper was collected into two volumes, and Mr Moore died soon after.

Moore || Moorlands.

MOORE, DR JOHN. See SUPPLEMENT.

MOORING, the act of confining and securing a ship in a particular station, by chains or cables, which are either fastened to the adjacent shore, or to anchors in the bottom.

A ship may be either moored by the head, or by the head and stern; that is to say, she may be secured by anchors before her, without any behind; or she may have anchors out, both before and behind her; or her cables may be attached to posts, rings, or moorings, which answer the same purpose.

When a ship is moored by the head with her own anchors, they are disposed according to the circumstances of the place where she lies and the time she is to continue therein. Thus, wherever the tide ebbs and flows, it is usual to carry one anchor out towards the flood, and another towards the ebb, particularly where there is little room to range about; and the anchors are laid in the same manner, if the vessel is moored head and stern in the same place. The situation of the anchors, in a road or bay, is usually opposed to the reigning winds, or those which are most dangerous; so that the ship rides therein with the effort of both her cables. Thus if she rides in a bay, or road, which is exposed to a northerly wind and heavy sea from the same quarter, the anchors passing from the opposite bows ought to lie east and west from each other: hence both the cables will retain the ship in her station with equal effort against the action of the wind and sea.

MOORINGS, in sea language, are usually an assemblage of anchors, chains, and bridles, laid athwart the bottom of a river or haven, to ride the shipping contained therein. The anchors employed on this occasion have rarely more than one fluke, which is sunk in the water near low-water mark. Two anchors being fixed in this manner on the opposite side of the river, are furnished with a chain extending across from one to the other. In the middle of the chain is a large square link, whose lower end terminates in a swivel, which turns round in the chain as about an axis, whenever the ship veers about with the change of the tide. To this swivel link are attached the bridles, which are short pieces of cable, well served, whose upper ends are drawn into the ship at the mooring ports, and afterwards fastened to the masts or cable bolts. A great number of moorings of this sort are fixed in the harbours adjacent to the king's dock-yards, as Deptford, Chatham, Portsmouth, Plymouth, &c.

MOORLANDS, a tract so called, in the north part of Staffordshire, where the land rises gradually into small hills, which run through the midst of England in one continued ridge, rising higher and higher to Scotland, and sending forth many rivers. The soil here is so foul and cold, that the snows lie almost all the year on the tops of the hills; and it is withal very rugged and barren: it, however, yields plenty of coal, lead, copper, rance-marble, and millstones; and some of the limestone hills bear such a sweet though short grass, as is very grateful to the oxen, of which here is

Moorlands || Mopsus.

a very good breed. It is observed here, that the west wind always brings rain, and the east and south fair weather; that though this tract is full of bogs, it is as healthy as any other part of the county; and that it produces the same plants as the Peak of Derby.

MOORS. See MOROCCO.

MOORS, in the Isle of Man, those who summon the courts for the several sheadings; such as the lords bailiffs. Every moor has the like office with our bailiff of the hundred.

MOOSE, or ELK. See CERVUS, MAMMALIA *Index*.

MOOT, a difficult case argued by the young barristers and students at the inns of court, by way of exercise, the better to qualify them for practice, and to defend the causes of their clients. This, which is called *mooting*, is the chief exercise of the inns of court. Particular times are appointed for the arguing moot cases: the place where this exercise is performed was anciently called *moot-hall*; and there is a bailiff, or surveyor of the moots, annually chosen by the bench to appoint the moot men for the inns of chancery, and to keep an account of the performance of exercises. The word is formed either from the Saxon *metan*, *gemetan*, "meeting"; or from the French *mot*, "a word."

MOPSUS, in fabulous history, a celebrated prophet, son of Manto and Apollo, during the Trojan war. He was consulted by Amphimachus, king of Colophon, who wished to know what success would attend his arms in a war which he was going to undertake. He predicted the greatest calamities; but Calchas, who had been a soothsayer of the Greeks during the Trojan war, promised the greatest successes. Amphimachus followed the opinion of Calchas; but the prediction of Mopsus was fully verified. This had such an effect upon Calchas, that he died soon after. His death is attributed by some to another mortification of the same nature. The two soothsayers, jealous of each other's fame, came to a trial of their skill in divination. Calchas first asked his antagonist, how many figs a neighbouring tree bore? 10,000 except one, replied Mopsus, and one single vessel can contain them all. The figs were gathered, and his conjectures were true. Mopsus now to try his adversary, asked him how many young ones a certain pregnant sow would bring forth? Calchas confessed his ignorance; and Mopsus immediately said that the sow would bring forth on the morrow ten young ones, of which only one should be a male, all black, and that the females should all be known by their white streaks. The morrow proved the veracity of his prediction; and Calchas died by the excess of grief which his defeat produced. Mopsus after death was ranked among the gods, and had an oracle at Malia, celebrated for the true and decisive answers which it gave. Another *Mopsus*, son of Ampyx and Chloris, born at Titaressa in Thessaly. He was the prophet and soothsayer of the Argonauts, and died at his return from Colchis by the bite of a serpent in Libya. Jason erected him a monument on the sea shore, where afterwards the Africans built him a temple, where he gave oracles. He has often been confounded with the son of Manto, as their professions and their names were alike.

Mopsus || Morai.

MORÆA, a genus of plants belonging to the triandria class; and in the natural method ranking under the 6th order, *Ensatæ*. See BOTANY *Index*.

MORAI, is the name given at Otaheite in the South sea to the burying grounds, which are also places of worship. This is a pile of stone raised pyramidically upon an oblong base or square 267 feet long and 87 wide. On each side is a flight of steps; those at the sides being broader than those at the ends; so that it terminated not in a square of the same figure with the base, but in a ridge like the roof of a house. There were 11 of these steps to one of these morais, each of which was 4 feet high, so that the height of the pile was 44 feet, each step was formed of one course of white coral stone, which was neatly squared and polished; the rest of the mass (for there was no hollow within) consisted of round pebbles, which, from the regularity of their figure, seemed to have been wrought. The foundation was of rock stones, which were also squared. In the middle of the top stood an image of a bird carved in wood, and near it lay the broken one of a fish carved in stone. The whole of this pyramid made part of one side of a spacious area or square 360 feet by 354, which was walled in with stone, and paved with flat stones in its whole extent. About 100 yards to the west of this building was another paved area or court, in which were several small stages raised on wooden pillars about seven feet high, which are called by the Indians *ewattas*, and seem to be a kind of altars, as upon these are placed provisions of all kinds, as offerings to their gods. On some of them were seen whole hogs, and on others the skulls of above 50, besides the skulls of many dogs. The principal object of ambition among the natives is to have a magnificent morai. The male deities (for they have them of both sexes) are worshipped by the men, and the female by the women; and each have morais, to which the other sex is not admitted, though they have also morais common to both.

MORAL PHILOSOPHY, or MORALS.

MORAL PHILOSOPHY is, "The science of MANNERS or DUTY; which it traces from man's nature and condition, and shows to terminate in his happiness." In other words, it is, "The knowledge of our DUTY and FELICITY;" or, "The art of being VIRTUOUS and HAPPY."

It is denominated an *art*, as it contains a system of rules for becoming virtuous and happy. Whoever practises these rules, attains an habitual power or facility of becoming virtuous and happy. It is likewise called a *science*, as it deduces those rules from the principles and connexions of our nature, and proves that the observance of them is productive of our happiness.

It is an art, and a science of the highest dignity, importance, and use. Its object is man's duty, or his conduct

duct in the several moral capacities and connexions which he sustains. Its office is to direct that conduct; to show whence our obligations arise, and where they terminate. Its use, or end, is the attainment of happiness; and the means it employs are rules for the right conduct of our moral powers.

Moral Philosophy has this in common with Natural Philosophy, that it appeals to nature or fact; depends on observation; and builds its reasonings on plain uncontroverted experiments, or upon the fullest induction of particulars of which the subject will admit. We must observe, in both these sciences, how nature is affected, and what her conduct is in such and such circumstances: Or, in other words, we must collect the appearances of nature in any given instance; trace these to some general principles or laws of operation; and then apply these principles or laws to the explaining of other phenomena.

Therefore Moral Philosophy inquires, not how man might have been, but how he is, constituted: not into what principles or dispositions his actions may be artfully resolved, but from what principles and dispositions they actually flow: not what he may, by education, habit, or foreign influence, come to be or do, but what, by his nature, or original constituent principles, he is formed to be and do. We discover the office, use, or destination of any work, whether natural or artificial, by observing its structure, the parts of which it consists, their connexion or joint action. It is thus we understand the office and use of a watch, a plant, an eye, or hand. It is the same with a living creature of the rational or brute kind. Therefore, to determine the office, duty, or destination of man; or, in other words, what his business is, or what conduct he is obliged to pursue; we must inspect his constitution, take every part to pieces, examine their mutual relations one to the other, and the common effort or tendency of the whole.

It has not been thus, however, that the science has always been taught. The earliest moralists did not erect systems upon a just analysis of the powers of the human mind; nor have all those who thought such a foundation necessary to be laid, deduced their theories from the very same principles. As moral truths are not capable of rigid demonstration, it appears to us, that we cannot more properly introduce the system which we have adopted, than by giving our readers a short view of the most celebrated systems that have been maintained by others. They will thus have an opportunity of judging for themselves of the respective merits of the different theories, and of adopting that which shall appear to them to place practical virtue on the firmest basis.

History of the Science of Morals.

1 Various opinions concerning the criterion of virtue, &c.

WHILST there has been a remarkable agreement among the writers on morality, as to the particular actions which are virtuous and those which are vicious; and whilst they have uniformly taught, that it is our duty and our interest to perform the one and to avoid the other; they have yet differed exceedingly concerning the *test* or *criterion* of virtue, as well as concerning the *principle* or *motive* by which men are induced to pursue it. One cause of this difference in opinion respecting matters of such universal importance, may perhaps be traced to the mistakes into which philosophers are apt to fall concerning the original state of man.

2 Probable cause of this variety.

It is very generally taken for granted, that the first men were savages of the lowest rank, and that the race gradually civilized itself during the course of many succeeding ages. Without mutual intercourse, the progress of civilization could never have commenced; and as the practice of justice is absolutely necessary to every species of friendly intercourse, those original savages, it is supposed, must have been just in their dealings, and just upon some principle which has its foundation in human nature. But to develope the principle by which savages are influenced in their conduct, no tedious or intricate process of reasoning can be necessary. It must have a place in every mind, and be instantaneous in all its decisions. Hence it has been supposed, that the principle to which modern philosophers have given the name of the *moral sense*, is instinctive; that it is the sole judge of virtue and vice; and that its admonitions have such authority, as to enforce obedience without regard to the consequences of any action.

Other philosophers, who deny that the moral sense is instinctive, and who yet suppose that the original state of man was savage, are forced to pile hypothesis upon hypothesis, each unnatural in itself, and all contradictory to one another, in order to account for the commencement of civilization and the formation of society. It has been supposed, that the desire of self-preservation and the love of power are the governing principles in human nature; that in the savage state every man had a right to every thing which he could seize by fraud or force; that all had an innate propensity to invade each other's property; and that hence war, rapine, and bloodshed, prevailed universally, till the savages discovered the expediency of uniting under some form of government for their mutual protection.

But before the original state of man had been made the basis of such opposite theories as these, it would surely have been proper to inquire upon what grounds that state has been supposed to be savage. To us these grounds appear to be nothing better than mere imaginations; the dreams of poets, and of such philosophers as bend facts to their own systems. In the authentic *history* of our species, there is no evidence, indeed there can be no evidence, that the first men were savages; and every thing which we know of human nature leads us to believe, that had they been so, the race could never have been civilized but by the miraculous interposition of some superior being. The only record of the earliest ages of the world to which the smallest credit is due, represents all the nations of the earth as having sprung from one pair, and that pair as having been instructed in their duty by their beneficent Creator. If this be the fact, and no consistent theist can controvert it, the precepts of morality would be originally conveyed from one generation to another; not in a systematical or scientific form, but as the laws of the Universal Sovereign, whose authority demanded implicit obedience. Accordingly we find, that the first teachers of morals were men of superior rank as well as of eminent talents, who formed collections of maxims derived from their ancestors, "with the

3 Modes of communicating instruction by the earliest moralists.

view

view of perfecting subordination *, polishing manners, and educating youth. Such were the proverbs of Solomon, the Words of Agur, and the Wisdom of the son of Sirach." These instructors did not analyze the human mind into its various faculties, and build a system of morals either upon a particular instinct pointing to the supreme good, or upon the fitness of things discovered by reason. Short isolated sentences were the mode in which they conveyed their precepts; which they prefaced by observing, that "the fear of the Lord is the beginning of knowledge;" and enforced by the assurance, that "length of days, and long life, and peace, should they add to those who obeyed them." The sayings of the celebrated wise men of Greece were collections of apophthegms, made in the same manner, and delivered with similar views. Thales and Pythagoras †, who founded the one the Ionic and the other the Italic school, made collections of precepts for the conduct as well of a state as of private life. "Neither the crimes nor the thoughts of bad men (said Thales) are concealed from the gods. The only method of being just, is to avoid doing that which we blame in others." Of Pythagoras it is related by Porphyry and Laertius, that from Samos he repaired to Delos, and after presenting an offering of cakes to Apollo, there received, or pretended to receive, moral dogmas from the priestess; which he afterwards delivered to his disciples under the character of divine precepts. Amongst these were the following: That, "next to gods and demons, the highest reverence is due to parents and legislators; and that the laws and customs of our country are to be religiously observed."

* *Bruce's Elements of the Science of Ethics.*

† *Bruce's Elements*, and *Enfield's History of Philosophy.*

To these maxims or apophthegms, which, for the sake of delighting the ear and aiding the memory, were sometimes delivered in verse, succeeded, as has been supposed, the mode of instruction by fable or allegory. But the truth seems to be, that this method of communicating moral and political wisdom was as ancient as the other: for we have a beautiful specimen of it in the ninth chapter of the book which relates the transactions of the Judges of Israel. The fables of Esop, too, which were written at a very early period, remain lasting modes of this species of art among the Greeks.

When the instructors of mankind had proceeded thus far as to give an artificial form to their precepts, they soon advanced a step farther, and reduced their observations into classes or predicaments. Pythagoras, who visited Egypt, has been supposed to have learned from its priests the method of arranging the virtues into distinct classes. But it is the opinion of an excellent writer ‡, founded on the previous aspects of ethics, and on the comprehensive talents of the Samian philosopher, that the honour of the invention ought to be ascribed to himself. Be this as it may, it was observed by the inventor, that "all the maxims of morality might be referred to the duties which men owe to themselves, and the duties which they owe to each other." Hence the four cardinal virtues of the ancients, PRUDENCE, TEMPERANCE, FORTITUDE, and JUSTICE; of which the first three refer to the individual, and the fourth to society.

‡ Mr *Bruce.*

4 The Moral principles of Socrates.

Hitherto lessons in morality had not taken a systematic form; but they were gradually approaching to it. Socrates was perhaps the first Pagan philosopher who established all his precepts on one sure and steady basis. In his lectures and discourses, he seems to have had one great object in view ‡, to connect the moral maxims which were fitted to regulate the conduct of mankind, with sublime conceptions respecting the character and government of a supreme Being. The first principles of virtuous conduct which are common to all mankind, are according to this excellent moralist, laws of God: and the conclusive argument by which he supports this opinion is, that no man departs from these principles with impunity. "It is frequently possible (says he) for men to screen themselves from the penalty of human laws, but no man can be unjust or ungrateful without suffering for his crime; hence I conclude, that these laws must have proceeded from a more excellent legislator than man." From this it would appear, that in the opinion of Socrates, conscience, or the moral sense, approving of any action, is the criterion by which it is known to be virtuous, and the will of God that which obliges men to perform it.

‡ *Bruce's Elements* and *Enfield's History*, &c.

5 Origin of the Greek sects.

Socrates himself left no writings behind him, nor, as far as we know, offered any regular and complete theory of ethics. His disciples, however, who were numerous and distinguished, became the founders of the celebrated Greek sects. Among them the first great question was, "what are the foundations of virtue?" and the second, "what are the distinctions betwixt good and evil, happiness and misery?" The answers given to these important questions divided the philosophers and their disciples into distinct orders.

6 Theories of Plato.

In answer to the former question, Plato taught * that "virtue is to be pursued for its own sake; and that being a divine attainment, it cannot be taught, but is the gift of God." This seems to differ in nothing, but the name, from the doctrine of those moderns who place the sole foundation of virtue in the approbation of the moral sense. The founder of the academy indeed has no such phrase as *moral sense* in any of his writings with which we are acquainted; but if virtue cannot be taught, and if it is to be pursued for its own sake, it must in itself be *good*, and the object of some feeling, whether called *sense*, *instinct*, or *passion*. His solution of the second question agitated among the sects is not indeed very consistent with this necessary inference from his answer to the first; but for his inconsistencies we are not accountable. "Our highest good (he says) consists in the contemplation and knowledge of the first good, which is mind or God; and all those things which are called *good* by men, are in reality such only so far as they are derived from the first and highest good. The only power in human nature which can acquire a resemblance to the supreme good, is reason; and this resemblance consists in prudence, justice, sanctity, and temperance."

* *Enfield.*

7 Aristotle,

Aristotle, the founder of the Peripatetic school, was the pupil of Plato; but of the two great moral questions he gives solutions somewhat different from those of his master. "Virtue (according to him ‡) is either theoretical or practical. Theoretical virtue consists in the due exercise of the understanding; practical, in the pursuit of what is *right* and *good*. Practical virtue is acquired by habit and exercise." This theory seems to differ little from that adopted by Cudworth, Clarke, and Price, which shall be considered afterwards.

‡ *Enfield.*

With

With respect to happiness or good, the doctrine of Aristotle is very rational. "Pleasures (he says) are essentially different in kind. Disgraceful pleasures are wholly unworthy of the name. The purest and noblest pleasure is that which a good man derives from virtuous actions. Happiness, which consists in a conduct conformable to virtue, is either contemplative or active. Contemplative happiness, which consists in the pursuits of knowledge and wisdom, is superior to active happiness, because the understanding is the higher part of human nature, and the objects on which it is employed are of the noblest kind. The happiness which arises from external possessions is inferior to that which arises from virtuous actions; but both are necessary to produce perfect felicity."

8 of the Stoics, * *Enfield.*

The Stoics, another celebrated sect of Greek philosophers, maintained *, that "nature impels every man to pursue whatever appears to him to be good." According to them, "self-preservation and defence is the first law of animated nature. All animals necessarily derive pleasure from those things which are suited to them; but the first object of pursuit is, not pleasure, but conformity to nature. Every one, therefore, who has a right discernment of what is good, will be chiefly concerned to conform to nature in all his actions and pursuits. This is the origin of moral obligation." With respect to happiness or good, the Stoical doctrine was altogether extravagant: They taught, that "all external things are indifferent, and cannot affect the happiness of man; that pain which does not belong to the mind, is no evil; and that a wise man will be happy in the midst of torture, because virtue itself is happiness (A)."

As the Stoics held that there is but one substance, partly active and partly passive, in the universe (see METAPHYSICS, N° 261, 262), and as they called the active principle *God*, their doctrine, which makes virtue consist in a conformity to *nature*, bears no small resemblance to that of those moderns who rest moral obligation on the *Divine will*. It was therefore on better grounds than has been sometimes supposed, that Warburton, when characterizing the founders of the three principal sects in Greece, represented † *Plato*, as the patron of the *moral sense*; *Aristotle* of the *essential differences*; and *Zeno* of *arbitrary will*. These principles, when separated from each other, and treated in the manner of the ancients, may not each be able to bear the superstructure which was raised upon it; but the principles of most of the other sects were much less pure, and infinitely more dangerous.

† *Div. Leg. of Moses.*

‡ *Eternal and immutable Morality.*

Cudworth ‡, whose testimony when relating the doctrines of antiquity is entitled to the fullest credit, affirms, that Aristippus the founder of the Cyrenaic school, Democritus, and Protogoras, with their followers among the atomists, taught, that "the distinction between virtue and vice is merely arbitrary; that nothing is just or unjust, sacred or profane, but as it is agreeable or contrary to established laws and customs; that what is just to-day, human authority may make unjust to-morrow; and that present pleasure is the sovereign good of man."

9 of Aristippus, Democritus, and Protagoras;

10 and of Epicurus.

With these impieties, the moral doctrines of Epicurus have very unjustly been confounded. The physical and metaphysical systems of that philosopher are indeed strange compositions of ingenuity and absurdity, truth and falsehood; and the moral precepts of many of his followers were in the highest degree licentious and impure. But his own life was exemplary; and his ethical system, if candidly interpreted, is much more rational than that of the Stoics; though it must be confessed, that no sect produced men of more determined virtue than the school of Zeno. According to Epicurus *, "the end of living, or the ultimate good which is to be sought for its own sake, is happiness. The happiness which belongs to man, is that state in which he enjoys as many of the good things, and suffers as few of the evils incident to human nature as possible; passing his days in a smooth course of tranquillity. Pleasure is in its own nature good, as pain is in its nature evil. The one is therefore to be pursued, and the other to be avoided, for its own sake. Pleasure and pain are not only good and evil in themselves, but they are the measures of what is good or evil in every object of desire and aversion; for the ultimate reason why we pursue one thing and avoid another is, because we expect pleasure from the former, and apprehend pain from the latter.—That pleasure, however, which prevents the enjoyment of a greater pleasure, or produces a greater pain, is to be shunned; and that pain which either removes a greater pain, or procures a greater pleasure, is to be endured."

* *Enfield's History.*

Upon these self-evident maxims, Epicurus builds his system of ethics; and proves, with great force of argument, "that a steady course of virtue produces the greatest quantity of happiness of which human nature is capable." Without a *prudent* care of the body, and a steady government of the mind, to guard the one from diseases and the other from the clouds of prejudice, happiness is unattainable. By *temperance* we enjoy pleasure, without suffering any consequent inconvenience. *Sobriety* enables us to content ourselves with simple and frugal fare. *Gentleness*, as opposed to an irascible temper, greatly contributes to the tranquillity and happiness of life, by preserving the mind from perturbation, and arming it against the assaults of calumny and malice. *Fortitude* enables us to bear those pains which prudence cannot shun, and banishes fear from the mind; and the practice of *justice* is absolutely necessary to the existence of society, and by consequence to the happiness of every individual." These reasonings come home to every man's bosom: and had not this philosopher, by denying the providence, if not the being, of God, most unhappily excluded from his system the very possibility of a future state of retribution, his moral philosophy would have been the most rational, and of course the most useful, of any that

(A) Since this short history was written, a very pleasing view of Stoicism has been given to the public in Ferguson's Principles of Moral and Political Science; a work which the student of ethics will do well to consult. Perhaps the amiable author may unintentionally have softened the austere dogmas of the Porch, by transfusing into them something of the mild spirit of the gospel; but, if so, he has much improved the system of Zeno.

that was taught in the schools of Greece. This enormous defect, however, laid it open to the grossest corruptions; and by his followers it was in fact corrupted so as to countenance the most impure and criminal pleasures of sense.

11 The eclectic philosophers of Alexandria.

These several systems of ethics continued to be cultivated with more or less purity through all the revolutions of the Grecian states, and they were adopted by the Romans after Greece itself became a province of the empire. They had been introduced into Egypt during the reigns of the Ptolemies, and were taught with much celebrity in the schools of Alexandria.—The philosophy which was most cultivated in those schools was that of Plato; but from a desire of uniformity which took possession of the Alexandrian Platonists, many of the dogmas of Aristotle and Zeno, as well as the extravagant fictions of the east, were incorporated with the principles of the old academy.—The patrons of this heterogeneous mass have been called *eclectic* philosophers, because they professed to select from each system those doctrines which were rational and important, and to reject every thing which was false or futile; but they added nothing to the purity of Plato's ethics, and they increased the obscurity and mysticism of his physics and metaphysics.

12 Extinction and revival of moral science in Europe.

After the subversion of the Roman empire, every species of philosophy, if syllogistic wrangling deserve not that name, was banished for ages from the schools of Europe; and ethics, properly so called, gave place to ecclesiastical casuistry, and to the study of the civil and canon law. When the Greeks, whom the fury and fanaticism of Mahomet II. had driven from Constantinople, introduced into Italy the knowledge of their own language, the cabinets of ancient philosophy were again unlocked; the systems of the different sects were adopted with the utmost avidity; and, without accurate investigation of their respective merits, men became Platonists, Peripatetics, or Stoics, as fancy or caprice prompted them to choose their leaders. The αυτος εφη of Aristotle, in particular, had not less authority over his modern admirers than it had of old in the Lyceum at Athens. At length the spirit of Luther and the genius of Bacon broke these fetters, and taught men to think for themselves as well in science as in religion. In physics, the effects produced by the writings of Bacon were great and rapid; for in physics the ancient theories were totally and radically wrong.—With respect to morals, however, the case was different. Each of the celebrated schools of antiquity was in possession of much moral truth, blended indeed with error: and long after the Stagyrite and his rivals had lost all influence in physical science, philosophers of eminence followed them implicitly in the science of ethics.

13 Theories of Hobbes,

At this day, indeed, there is hardly a theory of morals at all distinguished, to which something very similar may not be found in the writings of the ancients.—Hobbes adopted the principles of Democritus and Protagoras, and taught expressly that "there is no criterion of justice or injustice, good or evil, besides the laws of each state; and that it is absurd to inquire at any person except the established interpreters of the law, whether an action be right or wrong, good or evil (B)." These impious absurdities have been often confuted. Cudworth, who composed his *True Intellectual System of the Universe*, in order to trace the metaphysical atheism of Hobbes to its source, and to expose it to the public in all its weakness, undertook likewise to overthrow his ethical system, in a treatise, entitled *Of Eternal and Immutable Morality*. That work was left unfinished; but the theory of its great author was adopted, illustrated, and very ably supported, by the doctors Clarke and Price.

14 of Cudworth, Clarke, and Price.

According to these three admirable scholars, "we feel ourselves irresistibly determined to approve some actions, and to disapprove others. Some actions we cannot but conceive of as *right*, and others as *wrong*; and of all actions we are led to form some idea, as either *fit* to be performed, or *unfit*, or as neither fit nor unfit to be performed, i. e. as *indifferent*. The power within us which thus perceives and determines, they declare to be the *understanding*; and they add, that it perceives or determines immediately or by intuition, because *right* and *wrong* denote *simple ideas*. As there are some propositions, which when attended to necessarily determine all minds to *believe* them, so are there some actions whose natures are such, that when observed, all rational beings immediately and necessarily *approve* them. He that can impartially attend, it is said, to the nature of his own perceptions, and determine that when he conceives gratitude or beneficence to be *right*, he perceives nothing *true* of them, or *understands* nothing, but only *suffers* from a sense, has a turn of mind which appears unaccountable: for the more we examine, the more indisputable it will appear to us, that we express *necessary* truth, when we say of some actions that they are right, and of others that they are wrong." It is added, that "we cannot perceive an action to be right without *approving* it, or *approve* it without being conscious of some degree of *satisfaction* and complacency; that we cannot perceive an action to be wrong without *disapproving* it, or *disapprove* it without being *displeased* with it; and that the *first* must be liked, the *last* disliked; the *first* loved, the *last* hated." By the patrons of this system, *obligation* to action, and *rightness* of action, are held to be coincident or identical. "Virtue, they affirm, has a real, full, obligatory power, antecedently to all laws, and independently of all will; for obligation is involved in the very nature of it. To affirm that the performance of that which to omit would be wrong is not obligatory, unless conducive to private good, or enjoined by a superior power, is a manifest contradiction *."

Few men have deserved better of letters and philosophy than Cudworth, Clarke, and Price; and yet their theory of morals appears to us to be contradictory and unintelligible. It is certainly romantic, and founded upon principles which, if they be denied, no man

* *Price's Review, and Clarke on the Attributes.*

(B) Doctrinas de justo et injusto, bono et malo, præter leges in unaquaque civitate constitutas, authenticas esse nullus: et utrum aliqua actio justa vel injusta, bona vel mala futura sit, à nemine inquirendum esse, præterquam ab illis, quibus legum suarum interpretationem civitas demandaverit. *De Cive*, p. 343.

man by argument can be compelled to grant. There is, say they, an absolute right and wrong, fitness and unfitness, in actions; but if so, the actions which are *right* and *fit* must be right and fit for something, because fitness, which respects no end, is wholly inconceivable. To say that any particular action is *fit*, and yet fit for *no particular purpose*, is just as absurd as to say that the angles at the base of an isosceles triangle are *equal* but neither to *one another*, nor to *any other angles;* and we may with no less propriety talk of the relation of equality attaching to a particular angle, and to nothing else with which the angle is equal, than of the *absolute* fitness or rightness of any action or course of actions. If it be said that such actions are fit and right, because they tend to promote the harmony of the world and the happiness of men, this may be granted; but it overturns the intellectual theory from its very foundation. Actions which are fit and right only for their consequences, are approved and liked for the sake of those consequences; and the happiness of men, among whom the virtuous person himself is certainly to be included, is the motive or ultimate obligation to their performance.

Similar to this theory, and liable to the same objections, is that which resolves moral approbation into a sense of propriety: for if actions be approved because they are proper, it must be because they are proper for some *end* or *purpose*, propriety in the abstract being a word without meaning.

15 Of Lord Shaftesbury, Hutcheson, &c.

Many philosophers, feeling the force of these and of similar objections to the intellectual theory of Cudworth, Clarke, and Price, as well as to a sense of *propriety* in the abstract, have had recourse to another hypothesis, apparently better founded. Observing that all mankind decide on the morality of characters and actions instantaneously, without weighing their consequences in the balance of reason, they suppose that such decisions are made by an *instinct* of our common nature, implanted in the human breast by the hand that formed it. To this instinct some of them give the name of *conscience*, and others that of *moral sense*, in contradiction to *external sense* the other great and universal inlet of human knowledge. By this *moral sense* we intuitively discover an essential difference in the *quality* of all thoughts and actions, and a general distinction of them into *good* and *evil*, just as by the *tongue* and *palate* we discover an essential difference in the *taste* of all objects, and a general distinction of them into *pleasant* and *unpleasant*. The ablest advocates for this instinctive system agree, that the moral sense is the immediate and involuntary criterion of only a few general truths, which in their joint operation upon the mind, lay the basis of moral obligation. Others have carried it to what we think a very dangerous extreme; as by affirming that we cannot prove, in regard to our moral feelings, that they are conformable to any extrinsic and eternal relations of things, they seem to wish that reason were banished from the science of ethics. Were this true, it would in many cases be impossible to distinguish the prejudices of early education from the pure dictates of original instinct, and the most pernicious conduct might be sanctified with the approbation of what would be deemed the ultimate test of virtue and vice.

To remedy the defects of the intellectual and instinctive theories of morality, Mr Hume blended them together; and, upon the broader basis of reason and internal sense co-operating with each other, he reared a system which, though different from those of all his predecessors, be rendered plausible, and supported with his usual ingenuity.

16 Of Mr Hume.

According to him, *sentiment* and *reason* concur in almost all moral determinations; and he proves, that for this purpose, "there is implanted in the human breast a disinterested principle of *benevolence* or *sympathy* which makes men take pleasure in each other's happiness. The merit or demerit of actions consists wholly in their utility or natural tendency to add to the sum of human happiness; and the same he holds to be true of qualities whether bodily or mental. This utility or natural tendency it is the office of reason to discover; for that faculty alone can trace relations and consequences. Such qualities or actions as reason discovers to be useful either to the individual or society, the instinctive principle of benevolence makes us instantly approve, and this approbation constitutes their morality. Thus temperance, fortitude, courage, industry, &c. reason discovers to be useful to him who possesses them; and upon this discovery they are approved of by the sentiment of sympathy. They are therefore moral qualities and the sources of the *private* virtues. In like manner, generosity, cheerfulness of temper, mercy, and justice, are discovered to be useful to society, and are accompanied with the approbation of that sentiment of sympathy which makes every man feel a satisfaction in the felicity of all other men. They therefore constitute the *social* virtues. Of every quality and every action, the merit or demerit, and of consequence the degree of approbation or disapprobation which is bestowed upon it, is in exact proportion to its utility and the circumstances of the case in which it occurs. The social virtues are therefore greater than those which are private, and one social virtue is greater than another; but every quality and every action which is useful, either to society or to the individual, is more or less virtuous, provided the good of the individual be considered as subordinate to the good of the public."

This theory is ingenious: and in placing the merit of actions in their utility, it furnishes a criterion of virtue which can be employed by reason; but it seems not to be wholly free from error, and it is obviously defective. By pretending that the same sentiment of approbation is given to useful actions voluntarily performed and to useful qualities which are merely constitutional, Mr Hume confounds the merit of virtuous habits with the value of natural talents. Yet every man's consciousness will surely tell him, that the feeling or sentiment which attaches to deeds of justice, clemency, and beneficence, is very different from that which attaches to beauty of form, strength of body, vigour of mind, and mere extent of capacity. All these actions and qualities are useful; but when we approve of the former, besides attending to their utility, we consider them as in the man's power, and attribute the merit of them immediately to himself. When we approve, or rather admire, the latter on account of their utility, we know them to be not in the man's power, and we attribute the merit of them immediately to the Author of nature.

But the defects of this theory are in practice more

pernicious than its errors. The author well observes that the end of all moral speculations is to teach us our duty, and by proper representations of the deformity of vice and beauty of virtue, to beget correspondent habits, and engage us to avoid the one and embrace the other; but the theory under review holds out no motive sufficient in all cases for this purpose.

It is indeed true, as Mr Hume affirms, that the virtues which are immediately useful or agreeable to the person possessed of them, are desirable in a view to self-interest, and that a regard to self-interest ought to engage us in the pursuit. It is likewise true, that the virtues which are *useful* and *agreeable* to others, are generally more desirable than the contrary qualities; for as by the constitution of our nature no enjoyment is sincere without some reference to company and society; so no society can be agreeable, or even tolerable, where a man feels his presence unwelcome, and discovers all around him symptoms of disgust and aversion. These considerations he deems sufficient to enforce the duties of humanity, clemency, and beneficence; but he states a case himself in which they would certainly fail to make a man abstain from his neighbour's property. The greater part of property he considers, and rightly considers, as having its foundation in human laws, which are so calculated as to preserve the peace and promote the general good of the society, at the unavoidable expence sometimes of the individual. Now, in particular incidents, a sensible knave, by secretly purloining from the hoards of a worthless miser, might make himself comfortable and independent for life, without causing any breach in the social union, and even without hurting a single individual. What then should hinder him from acting thus? His self-interest would be promoted; and if he possessed a generous spirit, he might gratify his sentiment of benevolence or sympathy by doing good with his money to the poor, which the miser never did. For enforcing the uniform practice of justice in such cases as this, Mr Hume's theory of morals contains no adequate motive; but a very sufficient one is held out by the system which we are now to consider.

17 A system of ethics built upon religion.

That system, which seems to have been unknown to the ancients, is built upon religion, of which indeed it constitutes a very essential part; and those by whom it has been taught, maintain that no other foundation is sufficient to bear a regular superstructure of practical ethics. The philosophers of this school (D) define virtue to be "the doing good to mankind, in obedience to the will of God, and for the sake of everlasting happiness:" So that with them "the good of mankind" is the *subject*, "the will of God" the *criterion* or *rule*, and "everlasting happiness" the *motive*, of human virtue. The moral sense, supposing it real, they consider as a very inadequate rule of conduct, as being in many cases difficult to be distinguished from prejudice; and many of them confidently deny its existence. The other rules, such as the *fitness of things*, abstract *right*, the *truth of things*, the *law of reason*, &c. they consider either as unintelligible, or as relative to some end by which the rules must themselves be tried. The two great questions, which in the system of these religious philosophers demand solution, are: 1*st*, By what means shall a man in every case discover precisely what is the will of God? and, 2*dly*, What evidence have we that there will be a future state of retribution and of everlasting happiness?

Of these two questions, the latter belongs wholly to religion; and to solve it they call in the aid of revelation, as well as of that which is called the religion of nature. The former question is in the province of morality; and to find answers to it which will apply to every case, is the whole business of their system.

The will of God respecting human conduct may be discovered by reasoning *à priori* from his existence and attributes, or *à posteriori* from the tendency of his works. Being himself independent and all perfect, it is inconceivable that his view in creating the world could be any thing else than to communicate some portion of his own felicity. (See METAPHYSICS, N° 312). This conclusion is agreeable to what we perceive of his works, in which there are a thousand contrivances, all tending to give happiness to man, and to all animated nature; and of not one of which the natural tendency is to inflict pain, or prove ultimately injurious. Mankind are linked together by various ties, and made to depend in a great measure upon each other's conduct. That conduct, therefore, which is naturally productive of the greatest sum of human happiness, must be agreeable to the will of God; or, in other words, virtuous conduct. That, of which the natural tendency is the reverse, must be vicious; and that conduct, if there be any such, which tends to produce neither happiness nor misery, must be indifferent, i. e. neither morally good nor morally evil. It is to be observed, however, that as, previous to their own obedience or disobedience, all men stand in the same relation to their Creator, it must be his will that an equal portion of the happiness of which human nature is capable be communicated to all by whom that nature is shared. Whence it follows, that only such conduct as, if universally pursued by all men in the same station and circumstances, would be productive of the greatest sum of human happiness on the whole, can be agreeable to the will of the Creator; and that, in judging of the morality of actions, we are not to regard their immediate consequences in a particular case, but their natural and ultimate tendency if performed in all cases.

This is a criterion of virtue which differs widely from the local or occasional utility set up by Mr Hume: for the particular consequences of an action and its general tendency may often be at variance, so that what might in certain circumstances be immediately useful, would yet be highly criminal and ultimately pernicious. The general tendency of actions, too, may be always known, and known with the utmost certainty: the whole of their particular consequences can never be discovered. One thing, however, is evident, that if all men in their respective stations would regulate their conduct by the natural tendency

(D) GASTREL, CUMBERLAND, PUFFENDORFF, NORRIS, BERKELEY, GAY, LAW, RUTHERFORTH, SOAME JENYNS, Dr JOHNSON, Mr PALEY, and Mr GISBORNE, &c.

dency of every action, the *particular* and *general* consequences of their conduct would be the same, and the greatest happiness would result from it of which human nature is in this world capable. And therefore, since it is only through the perverseness of some person or persons concerned, that the *particular consequences* of any action, of which the *natural tendency* is to produce *misery*, can ever bring *happiness* to a single individual; it can no more be the will of God that we make these *occasional* and *distorted* consequences the rule of our conduct, than it can be his will that the *vices* of other men should be the basis of our *virtues*. According to this scheme of morals, which rests all obligation on private happiness, the whole difference between an act of *prudence* and an act of *duty*, is this: That in the former case we consider only what we shall gain or lose in this world; in the latter, what we shall gain or lose in the world to come.

Although the patrons of this theory question the reality of the moral sense as an instinct, they allow that a sentiment of approbation or disapprobation of actions, according as they are virtuous or vicious, is generated by the associating principle (see INSTINCT, and METAPHYSICS, N° 97.); and that this sentiment, though factitious, operates instantaneously as if it were instinctive. They insist that our earliest actions are the result of imitation; that when we first begin to trace consequences, education and the desire of immediate enjoyment are our only guides; that as our mind expands and our knowledge increases, the hopes and fears of futurity become the *motives*, and the will of God the *rule* of our conduct; and that long practice in virtue, upon these principles, produces habits by which we go on with satisfaction in the same course, without looking forward on every *particular* occasion, to the ultimate consequences and first motives of our actions. Thus do habits of justice, benevolence, clemency, and moral approbation, spring through a proper course of discipline, out of the selfish principle; and when these habits are completely formed and deeply rooted, man has attained the utmost perfection of which he is capable in this state of probation, and is fitted for another of retribution and happiness.

19 Defects and excellency of the system.

That these philosophers have not a just view of human nature, when they deny that there are any innate principles of benevolence in man, we shall endeavour to show when we lay the foundation of that theory which we think deserves to be preferred to all others; but we fully agree with a candid and able writer*, who seems to consider them as under the same mistake, "that their theory of morals has no tendency to weaken the foundations of virtue; and that by the account which it gives of the rise of the social affections, it obviates many of the arguments which had formerly been urged against the selfish system." Nay, we scruple not to confess, that the mode of investigation which it employs in *all cases* to discover the will of God, may in *some cases* be necessary in any system which does not banish the use of reason from the science of ethics. On this account, as well as out of respect to the first moralist† of the age, who affirms, that "it must be embraced by all who are willing to know why they act, or why they forbear, to give any reason of their conduct to themselves or to others," we shall apply it to one of those cases of social duty which Mr Hume's principle of utility could not resolve. Such an example will enable the meanest of our readers to decide between the merits of it and of the theory which we shall adopt; or, as we rather hope, it will show them that the two theories lead to the same practical conclusions.

* *Stuart's Elements of the Philosophy of the Human Mind.*

† *Johnston*

Having thus given our readers a short view of the most celebrated systems of ethics which have prevailed from the earliest ages of the world to the present day, we now proceed, agreeably to our definition of the science, to trace man's duty from his nature and connexions, and to show that the steady practice of virtue must terminate in his ultimate happiness.

PART I.

CHAP. I. *Of* MAN *and his* CONNEXIONS.

20 Man's infant state.

MAN is born a weak, helpless, delicate creature, unprovided with food, clothing, and whatever else is necessary for subsistence or defence. And yet, exposed as the infant is to numberless wants and dangers, he is utterly incapable of supplying the *former*, or securing himself against the *latter*. But, though thus feeble and exposed, he finds immediate and sure resources in the *affection* and *care* of his parents, who refuse no labours, and forego no dangers, to nurse and rear up the tender babe. By these powerful instincts, as by some mighty chain, does nature link the *parent* to the *child*, and form the strongest *moral connexion* on his part, before the child has the least apprehension of it. *Hunger* and *thirst*, with all the sensations that accompany or are connected with them, explain themselves by a language strongly expressive, and irresistibly moving. As the several senses bring in notices and informations of surrounding objects, we may perceive in the young spectator early signs of a growing *wonder* and *admiration*. Bright objects and striking sounds are beheld and heard with a sort of commotion and surprise. But, without resting on any, he eagerly passes on from object to object, still pleased with whatever is newest. Thus the *love* of *novelty* is formed, and the passion of *wonder* kept awake. By degrees he becomes acquainted with the most familiar objects, his parents, his brethren, and those of the family who are most conversant with him. He contracts a *fondness* for them, is uneasy when they are gone, and charmed to see them again. These feelings become the foundation of a *moral attachment* on his side; and by this reciprocal sympathy he forms the domestic alliance with his parents, brethren, and other members of the family. Hence he becomes interested in their concerns; and feels *joy* or *grief*, *hope*, or *fear*, on their account, as well as his own. As his affections now point beyond himself to others, he is denominated a *good* or *ill* creature, as he stands *well* or *ill affected* to them. These, then, are the first links of the

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moral chain; the early rudiments, or outlines, of his character; his first rude essays towards agency, freedom, manhood.

21 His childhood.

When he begins to make excursions from the nursery, and extends his acquaintance abroad, he forms a little circle of companions, engages with them in play, or in quest of adventures; and leads, or is led by them, as his genius is more or less aspiring. Though this is properly the season in which *appetite* and *passion* have the *ascendant*, yet his *imagination* and *intellectual* powers open apace; and as the various images of things pass before the mental eye, he forms variety of tastes; relishes some things, and dislikes others, as his parents, companions, and a thousand other circumstances, lead him to combine agreeable or disagreeable sets of ideas, or represent to him objects in alluring or odious lights.

As his views are enlarged, his *active* and *social* powers expand themselves in proportion; the *love of action*, of *imitation*, and of *praise*, *emulation*, *curiosity*, *docility*, *a passion for command*, and *fondness of change*. His passions are quick, variable, and pliant to every impression; his attachments and disgusts quickly succeed each other. He compares things, distinguishes actions, judges of characters, and loves or hates them, as they appear well or ill affected to himself, or to those he holds dear. Meanwhile he soon grows sensible of the consequences of his own actions, as they attract applause, or bring contempt: he triumphs in the former; and is ashamed of the latter, wants to hide them, and blushes when they are discovered. By means of these powers he becomes a fit subject of culture, the moral tie is drawn closer, he feels that he is accountable for his conduct to others as well as to himself, and thus is gradually ripening for society and action.

22 His youth.

As man advances from *childhood* to *youth*, his passions as well as perceptions take a more extensive range. New senses of pleasure invite him to new pursuits; he grows sensible to the attractions of beauty, feels a peculiar sympathy with the sex, and forms a more tender kind of attachment than he has yet experienced. This becomes the cement of a *new moral relation*, and gives a softer turn to his passions and behaviour. In this turbulent period he enters more deeply into a *relish of friendship*, *company*, *exercises*, and *diversions*; the *love of truth*, of *imitation*, and of *design*, grows upon him; and as his connexions spread among his neighbours, fellow citizens, and countrymen, his *thirst of praise*, *emulation*, and *social affections* grow more intense and active. Meanwhile, it is impossible for him to have lived thus long without having become sensible of those more august signatures of order, wisdom, and goodness, which are stamped on the visible creation; and of those strong suggestions within himself of a parent mind, the source of all intelligence and beauty; an object as well as source of that activity, and those aspirations which sometimes rouse his inmost frame, and carry him out of himself to an almighty and all-governing power: Hence arise those sentiments of *reverence*, and those affections of *gratitude*, *resignation*, and *love*, which link the soul with the Author of Nature, and form that most sublime and godlike of all connexions.

23 His manhood.

Man having now reached his prime, either new passions succeed, or the old set are wound up to a higher pitch. For, growing more sensible of his connexions with the public, and that particular community to which he more immediately belongs; and taking withal a larger prospect of human life, and its various wants and enjoyments; he forms more intimate friendship, grasps at power, courts honour, lays down cooler plans of interest, and becomes more attentive to the concerns of society: he enters into family connexions, and indulges those charities which arise from thence. The *reigning* passions of this period powerfully prompt him to provide for the decays of life: and in it *compassion* and *gratitude* exert their influence in urging the *man*, now in full vigour, to requite the affection and care of his parents, by supplying their wants and alleviating their infirmities.

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24 Old age.

At length human life verges downwards; and *old age* creeps on apace, with its *anxiety*, *love of ease*, *interestedness*, *fearfulness*, *foresight*, and *love of offspring*. —The experience of the aged is formed to direct, and their coolness to temper, the heat of youth: the former teaches them to look back on past follies; and the latter to look forward into the consequences of things, and provide against the worst. Thus every age has its peculiar genius and set of passions corresponding to that period, and most conducive to the prosperity of the rest. And thus are the *wants* of one period supplied by the *capacities* of another, and the *weaknesses* of one age tally to the *passions* of another.

25 Passions of every age.

Besides these, there are other passions and affections of a less *ambulatory* nature, not peculiar to one period, but belonging to every age, and acting more or less in every breast throughout life. Such are *self-love*, *benevolence*, *love of life*, *honour*, *shame*, *hope*, *fear*, *desire*, *aversion*, *joy*, *sorrow*, *anger*, and the like. The two first are affections of a cooler strain; one pointing to the good of the individual, the other to that of the species: *joy* and *sorrow*, *hope* and *fear*, seem to be only modifications, or different exertions, of the same *original* affections of *love* and *hatred*, *desire* and *aversion*, arising from the different circumstances or position of the object desired or abhorred, as it is present or absent. From these likewise arise other *secondary* or *occasional* passions, which depend, as to their existence and several degrees, upon the original affections being gratified or disappointed; as *anger*, *complacence*, *confidence*, *jealousy*, *love*, *hatred*, *dejection*, *exultation*, *contentment*, *disgust*, which do not form *leading* passions, but rather hold of them.

26 Their joint effects.

By these simple but powerful springs, whether *periodical* or *fixed*, the life of man, weak and indigent as he is, is preserved and secured, and the creature is prompted to a constant round of action, even to supply his own numerous and ever-returning *wants*, and to guard against the various *dangers* and *evils* to which he is obnoxious. By these links men are connected with each other, formed into families, drawn into particular communities, and all united as by a common league into one system or body, whose members feel and sympathise one with another. By this admirable adjustment of the constitution of *man* to his *state*, and the gradual evolution of his powers, order is maintained, society upheld, and human life filled with that variety of passion and action which at once enliven and diversify it.

27 The directing power.

This is a short sketch of the *principal movements* of the

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the human mind. Yet these movements are not the whole of man; they impel to action, but do not direct it: they need a *regulator* to guide their motions, to measure and apply their forces; and accordingly they have one that naturally *superintends* and directs their action. We are conscious of a principle within us, which examines, compares, and weighs things; notes the differences, observes the forces, and foresees the consequences, of affections and actions. By this power we look back on past times, and forward into futurity, gather experiences, estimate the real and comparative value of objects, lay out schemes, contrive means to execute them, and settle the whole order and economy of life. This power we commonly distinguish by the name of *reason* or *reflection*, the business of which is not to suggest any original notices or sensations, but to canvass, range, and make deductions from them.

28 The judging or approving powers.

We are intimately conscious of another principle within us, which approves of certain *sentiments*, *passions*, and *actions*, and disapproves of their contraries. In consequence of the decisions of this inward judge, we denominate some actions and principles of conduct *right*, *honest*, *good;* and others *wrong*, *dishonest*, *ill*. The former excite our *esteem*, *moral complacence*, and *affection*, immediately and originally of themselves, without regard to their consequences, and whether they affect our interest or not. The latter do as naturally and necessarily call forth our *contempt*, *scorn*, and *aversion*. That power by which we perceive this difference in affections and actions, and feel a consequent relish or dislike, is commonly called *conscience* or the *moral sense*.

That there is such a power as this in the mind of every man of sound understanding, is a fact which cannot be controverted; but whether it be an instinctive power, or the result of early and deep-rooted associations, has been long and ably debated. The question is of importance in the science of human nature, as well as in ascertaining the standard of practical virtue; but to us it appears that the contending parties have carried their respective opinions to dangerous extremes.

When it is affirmed, as it sometimes has been, that reason has nothing to do in ethical science, but that in every possible situation our duty is pointed out and the performance of it enforced by mere sentiment, the consequence seems to be, that virtue and vice are nothing permanent in themselves, but change their nature according to local circumstances. Certain it is, that sentiment has in similar situations approved of very different practices in different ages and different nations. At present this sentiment in Europe approves of,

29 An attempt to prove that we have from nature no such powers.

the universal practice of justice, and of parents protecting their children, whether well or ill formed, whether strong or weak: but in Sparta we know that theft, if dexterously practised, was approved, and not unfrequently rewarded; and that the exposition of lame and deformed children was not only permitted, but absolutely enjoined. There is nothing which our conscience or moral sense condemns with greater severity, or views as a crime of a deeper dye, than children's unkind treatment of their aged parents; yet there are savages, among whom instincts of all kinds ought to prevail in greater purity than in civilized nations, whose moral sense permits them to put their aged and decrepid parents to death. If this sense be instinctive, and the sole judge of right and wrong, how comes it to decide so differently on the same line of conduct in different ages and distant countries? The instinct of brutes, in similar circumstances, prompt uniformly to similar actions in every age and in every region where the species is found; and the external senses of man afford in all nations the same unvaried evidence concerning their respective objects. To these observations we may add, that instincts must be calculated for the state of nature, whatever that state may be, and therefore cannot be supposed capable of directing our steps through all the labyrinths of polished society, in which duties are to be performed that in a state of nature would never have been thought of.

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But though for these reasons it is apparent that mere sentiment, whether called conscience or the moral sense, would *alone* be a very unsafe guide to virtue in every individual case that may occur, we think that those who resolve all such sentiment into habit and the effect of education, without giving any part of it to nature, advance an opinion which is equally ill-founded and not less dangerous. There are, indeed, men who affirm that all benevolence is hypocrisy, friendship a cheat, public spirit a farce, fidelity a snare to procure trust and confidence; and that while all of us at bottom pursue only our private interest, we wear those fair disguises, in order to put those off their guard with whom we have to deal, and to expose them the more to our wiles and machinations. Others again, too virtuous to accuse themselves and all mankind of direct knavery, yet insist, that whatever affection one may feel, or imagine he feels, for others, no passion is or can be disinterested; that the most generous friendship, however sincere, is only a modification of self-love; and that even unknown to ourselves we seek only our own gratification, while we appear the most deeply engaged in schemes for the liberty and happiness of mankind.

Surely the mildest of these representations is an exaggerated picture of the selfishness of man. Self-love is indeed a very powerful as well as an essential principle in human nature; but that we have likewise an instinctive principle of benevolence, which, without any particular regard to our own interest, makes us feel pleasure in the happiness of other men, is a fact which we think admits of very complete proof. For, as Mr Hume well argues, "when a man grieves for a friend who could be of no service to him, but on the contrary stood in need of his constant patronage and protection, how is it possible to suppose that such passionate tenderness arises from self-interest, which has no foundation in nature? What interest (asks the same deep thinker) can a fond mother have in view, who loses her health by her assiduous attendance on her sick child, and afterwards languishes and dies of grief when freed by its death from the slavery of attendance?—Have we no satisfaction (continues he) in one man's company above another's, and no desire of the welfare of our friend, even though absence or death should prevent us from all participation in it? Or what is it commonly that gives us any participation in it, even while alive and present, but our affection and regard to him?" Nor is it to contemporaries and individuals

30 Examined, and shown

alone,

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alone, that, independent of all interest, we feel a benevolent attachment. We constantly bestow praise on actions calculated to promote the good of mankind, though performed in ages very distant and in countries most remote; and he who was the author of such actions is the object of our esteem and affection. There is not perhaps a man alive, however selfish in his disposition, who does not applaud the sentiment of that emperor, who recollecting at supper that he had done nothing in that day for any one, exclaimed with regret, that the day had been lost! yet the utmost subtility of imagination can discover no appearance of interest that *we* can have in the generosity of *Titus*, or find any connexion of our present happiness with a character removed so far from us both in time and in place. But, as Mr Hume justly observes, if we even feign a character consisting of all the most generous and beneficent qualities, and give instances in which these display themselves, after an eminent and most extraordinary manner, for the good of mankind, we shall instantly engage the esteem and approbation of all our audience, who will never so much as inquire in what age or country the accomplished person lived.

These are facts which cannot be controverted; and they are wholly unaccountable, if there be not in human nature an instinctive sentiment of benevolence or sympathy which feels a disinterested pleasure in the happiness of mankind. But an end in which we feel pleasure we are naturally prompted to pursue; and therefore the same sentiment impels every man, with greater or less force, to promote the happiness of other men, which by means of it becomes in reality his own good, and is afterwards pursued from the combined motives of benevolence and self-enjoyment. For in obeying this sentiment we all feel an inward *complacency*, *self-approbation*, or consciousness of *worth*, or *merit*; and in disobeying it, which cannot be done but with reluctance, we feel *remorse*, or a consciousness of *unworthiness* or *demerit*. It appears, however, from history, that the sentiment, as it is instinctive, points only to the good of mankind, without informing us how that good is to be promoted. The means proper for this purpose must be discovered by reason; and when they are brought into view, this *sentiment*, *conscience*, or *moral sense*, instantly shows us that it is our duty to pursue them.

31 to originate in the objector's mistaking the extent of those powers;

Hence we see how different lines of conduct may in similar circumstances be approved of as virtuous in different nations. When the Spartan exposed his sickly and deformed child, and when the savage put his aged parents to death, neither of them erred from want of sentiment, or from having sentiments originally different from ours. Their errors resulted from a defect in reasoning. They both imagined that they were obeying the law of benevolence by preventing misery: for a weak and deformed person was very ill qualified to exist with any degree of comfort under the military constitution of Sparta, where all were soldiers, and under the necessity of enduring the greatest hardships; and in a state where the people have no fixed habitations, and where the chase supplies even the necessaries of life, an aged and infirm person is in danger of perishing through hunger, by one of the cruellest and most lingering of deaths. The theft allowed in Sparta, if theft it may be called, was a still less deviation from the instinctive law of benevolence. Boys were taught to slip as cunningly as they could into the gardens and public halls, in order to steal away herbs or meat; and if they were caught in the fact, they were punished for their want of dexterity. This kind of theft, since it was authorized by the law and the consent of the citizens, was no robbery; and the intention of the legislator in allowing it, was to inspire the Spartan youth, who were all designed for war, with the greater boldness, subtlety, and address; to inure them betimes to the life of a soldier; and to teach them to shift for themselves, and to live upon little. That the Spartan legislator did wrong in giving his countrymen a constitution, of which successful war was the ultimate object; and that savages, rather than kill their aged parents, or suffer them to die of hunger, ought to cultivate the ground, and abandon the chase; is readily granted: but the faults of the one as well as of the other arose not from any improper decision of the moral sense, but from a defect in their reasoning powers, which were not able to estimate the advantages and disadvantages of different modes of life. In moral decisions, therefore, conscience and reason are aiding to each other. The former principle, when separated from the latter, is defective, enjoining only the good of mankind, but unable to point out the means by which it can be most effectually promoted; and the latter principle, when separated from the former, only directs a man to do what is most prudent, but cannot give him a conception of duty.

32 which are different in nature and kind from the passions and affections.

These two powers of *reason* and *conscience* are evidently principles different in *nature* and *kind* from the passions and affections. For the passions are mere *force* or *power*, *blind impulses*, acting violently and without choice, and ultimately tending each to their respective objects, without regard to the interest of the others, or of the whole system. Whereas the *directing* and *judging* powers distinguish and ascertain the different forces, mutual proportions and relations, which the passions bear to each other, and to the whole; recognize their several degrees of merit, and judge of the whole temper and conduct, as they respect either the individual or the species; and are capable of directing or restraining the blind impulses of passion in a due consistency one with the other, and a regular subordination to the whole system.

33 Division of the passions.

This is some account of the *constituent principles* of our nature, which, according to their different mixtures, degrees, and proportions, mould our character and sway our conduct in life. In reviewing that large train of affections which fill up the different stages of human life, we perceive this obvious distinction among them; that some of them respect the *good* of the *individual*, and others carry us beyond ourselves to the *good* of the *species* or *kind*. The former have therefore been called *private*, and the latter *public* affections. Of the first sort are *love of life*, of *pleasure*, of *power*, and the like. Of the last are *compassion*, *gratitude*, *friendship*, *natural affection*, and the like. Of the *private* passions (D), some respect merely the *security* and *defence*, of the creature, such as *resentment* and *fear*; whereas others

(D) Here we use passions and affections without distinction. Their difference will be marked afterwards.

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others aim at some *positive* advantage or good, as *wealth*, *ease*, *fame*. The former sort, therefore, because of this difference of objects, may be termed *defensive* passions. These answer to our *dangers*, and prompt us to avoid them if we can, or boldly to encounter them when we cannot.

34 Defensive passions.

35 Private or appetitive passions.

The other class of *private* passions, which pursue *private positive* good, may be called *appetitive*. However, we shall still retain the name of *private* in contradistinction to the *defensive* passions. Man has a great variety of wants to supply, and is capable of many enjoyments, according to the several periods of his life, and the different situations in which he is placed. To these therefore a suitable train of *private passions* correspond, which engage him in the pursuit of whatever is necessary for his subsistence or welfare.

36 Public passions.

Our *public* or *social* affections are adapted to the several *social connexions* and *relations* which we bear to others, by making us sensible of their dangers, and interesting us in their wants, and so prompting us to secure them against one and supply the other.

This is the first step then to discover the *duty* and *destination* of man, the having analyzed the principles of which he is composed. It is necessary, in the next place, to consider in what *order*, *proportion*, and *measure*, of those inward principles, *virtue*, or a sound moral temper and right conduct, consists; that we may discover whence *moral obligation* arises.

Chap. II. *Of* Duty, *or* Moral Obligation.

37 The measure of powers.

It is by the end or design of any power or movement that we must direct its motions, and estimate the degree of force necessary to its just action. If it want the force requisite for the obtaining its end, we reckon it defective; if it has too much, so as to be carried beyond it, we say it is overcharged; and in either case it is imperfect and ill contrived. If it has just enough to reach the scope, we esteem it right and as it should be. Let us apply this reasoning to the passions.

38 Measure of the defensive passions.

The *defence* and *security* of the individual being the *aim* of the *defensive passions*, that *security* and *defence* must be the *measure* of their *strength* or *indulgence*. If they are so *weak* as to prove insufficient for that end, or if they *carry us beyond it*, i. e. raise unnecessary commotions, or continue longer than is needful, they are unfit to answer their original design, and therefore are in an unsound and unnatural state. The exercise of *fear* or of *resentment* has nothing desirable in it, nor can we give way to either without painful sensations. Without a certain degree of them, we are naked and exposed. With too high a proportion of them, we are miserable, and often injurious to others. Thus *cowardice* or *timidity*, which is the excess of fear, instead of saving us in danger, gives it too formidable an appearance, makes us incapable of attending to the best means of preservation, and disarms us of *courage*, our natural armour. *Fool hardiness*, which is the want of a due measure of *fear*, leads us heedlessly into danger, and lulls us into a pernicious security. *Revenge*, i. e. *excessive resentment*, by the violence of its commotion, robs us of that *presence of mind* which is often the best guard against injury, and inclines us to pursue the aggressor with more severity than self-defence requires. *Pusillanimity*, or the want of a just indignation against wrong, leaves us quite unguarded, and tends to sink the mind into a passive enervated tameness. Therefore, "to keep the defensive passions duly proportioned to our dangers, is their natural pitch and tenor."

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39 Measure of the private passions.

The *private* passions lead us to pursue some *positive* species of *private* good: that *good* therefore which is the object and end of each must be the measure of their respective force, and direct their operation. If they are too *weak* or *sluggish* to engage us in the pursuit of their several objects, they are evidently *deficient*; but if they defeat their end by their *impetuosity*, then are they strained beyond the just tone of nature. Thus *vanity*, or an *excessive passion for applause*, betrays into such meannesses and little arts of popularity, as make us forfeit the honour we so anxiously court. On the other hand, *a total indifference about the esteem of mankind*, removes a strong guard and spur to virtue, and lays the mind open to the most abandoned prosecutions. Therefore, "to keep our private passions and desires proportioned to our *wants*, is the just measure and pitch of this class of affections."

40 Comparative force.

The *defensive* and *private* passions do all agree in general, in their tendency or conduciveness to the interest or good of the individual. Therefore, when there is a collision of interest, as may sometimes happen, that *aggregate of good* or *happiness*, which is composed of the particular goods to which they respectively tend, must be the common standard by which their *comparative degrees* of strength are to be measured: that is to say, if any of them, in the degree in which they prevail, are incompatible with the greatest aggregate of good or most extensive interest of the individual, then are they unequal and disproportionate. For in judging of a particular *system* or *constitution* of powers, we call that the *supreme* or *principal* end, in which the aims of the several parts or powers coincide, and to which they are subordinate; and reckon them in due proportion to each other, and right with regard to the whole, when they maintain that subordination of subserviency. Therefore, "to proportion our defensive and private passions in such measure to our dangers and wants as best to secure the individual, and obtain the greatest aggregate of private good or happiness, is their just balance or comparative standard in case of competition."

41 Measure of the public affections.

In like manner as the *public* or *social* affections point at the good of others, that *good* must be the measure of their force. When a particular *social* affection, as *gratitude*, or *friendship*, which belongs to a particular *social connexion*, viz. that of a *benefactor*, or of a *friend*, is too feeble to make us act the *grateful* or *friendly* part, that affection, being insufficient to answer its end, is *defective* and *unsound*. If on the other hand, a particular passion of this class counteract or defeat the interest it is designed to promote, by its violence or disproportion, then is that passion *excessive* and *irregular*. Thus *natural affection*, if it degenerates into a *passionate* fondness, not only hinders the parents from judging coolly of the interest of their offspring, but often leads them into a most partial and pernicious indulgence.

42 Collision of social affections.

As every kind affection points at the good of its particular object, it is possible there may sometimes be a collision of interests or goods. Thus the regard due

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to a *friend* may interfere with that which we owe to a *community*. In such a competition of interests, it is evident that the *greatest* is to be chosen; and that is the greatest interest which contains the greatest sum or aggregate of public good, greatest in *quantity* as well as *duration*. This then is the *common standard* by which the respective forces and subordinations of the social affections must be adjusted. *Therefore* we conclude that "this class of affections are sound and regular when they prompt us to pursue the *interest* of *individuals* in an entire consistency with the *public good*;" or in other words, "when they are duly proportioned to the *dangers* and *wants* of others, and to the various *relations* in which we stand to *individuals* or to *society*."

Thus we have found, by an induction of particulars the *natural pitch* or *tenor* of the *different orders of affection*, considered apart by themselves. Now, as the *virtue* or *perfection* of every creature lies in following its nature, or acting suitably to the just proportion and harmony of its several powers; therefore, "the VIRTUE of a creature endowed with such affections as *man* must consist in observing or acting agreeably to their *natural pitch and tenor*."

43 Balance of affection.

But as there are no independent affections in the fabric of the mind, no passion that stands by itself without some relation to the rest, we cannot pronounce of any one, considered APART, that it is either *too strong* or *too weak*. Its strength and just proportion must be measured not only by its subserviency to its own immediate end, but by the respect it bears to the whole system of affections. Therefore we say a passion is *too strong*, not only when it defeats its own end, but when it impairs the force of other passions, which are equally necessary to form a *temper of mind* suited to a certain *economy* or *state*; and too weak, not merely on account of its insufficiency to answer its end, but because it cannot sustain its *part* or *office* in the balance of the whole system. Thus the *love of life* may be *too strong* when it takes from the *regard* due to one's country, and will not allow one bravely to encounter dangers, or even death, on its account. Again, The *love of fame* may be *too weak* when it throws down the fences which render virtue more secure, or weakens the incentives which make it more active and public spirited.

44 Limits of private affections.

If it be asked, "How far may the affections towards private good or happiness be indulged?" One limit was before fixed for the particular indulgence of each, viz. their subordination to the common aggregate of good to the private system. In these therefore a due regard is always supposed to be had to *health*, *reputation*, *fortune*, the *freedom of action*, the *unimpaired exercise of reason*, the *calm enjoyment of one's self*, which are all private goods. Another limit now results from the balance of affection just named, viz. "The security and happiness of others;" or, to express it more generally, "a *private* affection may be safely indulged, when, by that indulgence, we do not violate the obligations which result from our higher relations or public connexions." A just respect therefore being had to these boundaries which nature has fixed in the breast of every man, what should limit our pursuits of private happiness? Is nature sullen and penurious? or, does the God of nature envy the happiness of his offspring?

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45 Collision of interests.

Whether there is ever a real collision of interests between the *public* and *private* system of affections, or the ends which each class has in view, will be afterwards considered; but where there is no collision, there is little or no danger of carrying either, but especially the *public* affections, to excess, provided both kinds are kept subordinate to a discreet and cool *self-love*, and to a calm and universal *benevolence*, which principles stand as guards at the head of each system.

46 Result.

This then is the conduct of the passions, considered as *particular* and *separate* forces, carrying us out to their respective ends; and this is their balance or economy, considered as *compound* powers, or powers mutually related, acting in conjunction towards a *common* end, and consequently as forming a *system* or *whole*.

47 Subordination of powers.

Now, whatever adjusts or maintains this *balance*, whatever in the human constitution is formed for *directing* the passions so as to keep them from defeating their own end or interfering with each other, must be a principle of a *superior* nature to them, and *ought* to direct their measures and govern their proportions. But it was found that *reason* or reflection is such a principle, which points out the tendency of our passions, weighs their influence upon private and public happiness, and shows the best means of attaining either. It having been likewise found that there is another directing or controlling principle, which we call CONSCIENCE or the MORAL SENSE, which, by a native kind of authority, judges of affections and actions, pronouncing some *just* and *good*, and others *unjust* and *ill*; it follows, that the passions, which are mere impulse or blind forces, are principles inferior and subordinate to this *judging* faculty. Therefore, if we would follow the order of nature, i. e. observe the mutual respects and the subordination which the different parts of the human constitution bear one to another, the passions ought to be subjected to the direction and authority of the *leading* or *controlling* principles.

48 In what it consists.

We conclude, therefore, from this *induction*, that the *constitution* or *just economy* of *human nature* consists in a regular *subordination* of the *passions* and *affections* to the *authority* of *conscience* and the *direction* of *reason*.

49 Economy of nature or right temper.

That *subordination* is *regular*, when the proportion formerly mentioned is maintained; that is to say, "when the *defensive* passions are kept proportioned to our *dangers*; when the *private* passions are proportioned to our *wants*; and when the *public* affections are adapted to our *public connexions*, and proportioned to the wants and dangers of others."

50 Human virtue and perfection.

But the *natural state*, or the *sound* and *vigorous constitution* of any creature, or the *just economy* of its powers, we call its *health* and *perfection*; and the acting agreeably to these, its *virtue* or *goodness*. Therefore, "the *health* and *perfection* of man must lie in the aforesaid *supremacy* of *conscience* and *reason*, and in the *subordination* of the passions to their *authority* and *direction*. And his *virtue* or *goodness* must consist in acting agreeably to that *order* or *economy*."

51 how conformable to reason.

That such an ornament of the mind, and such a conduct of its powers and passions, will stand the test of *reason*, cannot admit of any dispute. For, upon a fair

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fair examination into the consequences of things, or the relations and aptitudes of *means* to *ends*, *reason* evidently demonstrates, and *experience* confirms it, that, "to have our *defensive passions* duly proportioned to our *dangers*, is the surest way to avoid or get clear of them, and obtain the security we seek after.—To proportion our *private passions* to our *wants*, is the best means to supply them;—and, to adapt our *public affections* to our *social relations*, and the *good* of others, is the most effectual method of fulfilling the *one*, and procuring the *other*." In this sense, therefore, *virtue* may be said to be a "*conduct* conformable to *reason*," as reason discovers an apparent *aptitude*, in such an *order* and *economy* of powers and passions, to answer the end for which they are *naturally* formed.

52 Connexion between affections and ends, not the idea of moral obligation.

If the idea of *moral obligation* is to be deduced merely from this *aptitude* or *connexion* between certain passions, or a certain order and balance of passions and certain ends obtained or to be obtained by them, then is *reason* or *reflection*, which perceives that aptitude or connexion, the proper judge of *moral obligation*; and on this supposition it may be defined, as hath been done by some, the connexion between the *affection* and the *end*, or, which is the same thing, between the *action* and the *motive*; for the *end* is the *motive* or the *final cause*, and the *affection* is the *action*, or its immediate natural cause. A man, from mere self-love, may be induced to fulfil that obligation which is founded on the connexion between the *defensive* passions and their *ends*, or the *private* passions and their *ends*; because in that case his own interest will prompt him to indulge them in the due proportion required. But if he has no affections which point beyond himself, no principle but *self-love*, or some subtle modification of it, what shall interest him in the happiness of others, where there is no connexion between it and his own? or what sense can he have of *moral obligation* to promote it? Upon this scheme, therefore, without public or social affection, there could be no *motive*, and consequently no moral obligation, to a beneficent disinterested conduct.

But if the mere connexion between certain passions or a certain order of passions, and certain ends, is what constitutes or gives us the idea of *moral obligation*, then why may not the appositeness of any temper or conduct, nay, of any piece of machinery, to obtain its end, form an equally strict *moral obligation*? for the connexion and aptitude are as strong and invariable in the latter instances as in the former. But as this is confounding the most obvious differences of things, we must trace the idea of *moral obligation* to another and a more natural source.

53 Idea of it from experience.

Let us appeal, therefore, to our inmost sense and experience, "how we stand affected to those different sets of passions, in the just measure and balance of which we found a right temper to consist." For this is entirely a matter of experience, in which we must examine, as in any other natural inquiry, "what are the genuine feelings and operations of nature, and what affections or symptoms of them appear in the given instance."

54 Why the defensive passions approved.

The defensive passions, as *anger* and *fear*, give us rather pain than pleasure, yet we cannot help feeling them when provoked by injury, or exposed to harm. We account the creature imperfect that wants them, because they are necessary to his defence. Nay, we should in some measure condemn ourselves, did we want the necessary degree of *resentment* and *caution*. But if our *resentment* exceeds the wrong received, or our *caution* the evil dreaded, we then blame ourselves for having overacted our part. Therefore, while we are in danger, to be totally destitute of them, we reckon a *blameable defect*, and to feel them in a just, i. e. necessary measure, we *approve*, as suited to the nature and condition of such a creature as man. But our security obtained, to continue to indulge them, we not only *disapprove* as *hurtful*, but *condemn* as *unmanly*, *unbecoming* and *mean-spirited*: Nor will such a conduct afford any self-approving joy when we coolly reflect upon it.

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55 Why the private.

With regard to the *private* passions, such as *love of life*, *pleasure*, *ease*, and the like, as these aim at private good, and are necessary to the perfection and happiness of the individual, we should reckon any creature *defective*, and even *blameable*, that was destitute of them. Thus, we condemn the man who imprudently ruins his fortune, impairs his health, or exposes his life; we not only pity him as an unfortunate creature, but feel a kind of *moral indignation* and contempt of him, for having made himself such. On the other hand, though a discreet self-regard does not attract our esteem and veneration, yet we approve of it in some degree, in a higher and different degree from what we would regard a well-contrived machine, as necessary to constitute a finished creature, nay, to complete the virtuous character, as exactly suited to our present indigent state. There are some passions respecting private good, towards which we feel higher degrees of approbation, as the *love of knowledge*, of *action*, of *honour*, and the like. We esteem them as marks of an ingenious mind; and cannot help thinking the character in which they are wanting remarkably stupid, and in some degree *immoral*.

56 Why the public.

With regard to the social affections, as *compassion*, *natural affection*, *friendship*, *benevolence*, and the like, we approve, admire, and love them in ourselves, and, in all in whom we discover them, with an esteem and approbation, if not different in kind, yet surely far superior in degree, to what we feel towards the other passions. These we reckon necessary, just, and excellently fitted to our structure and state; and the creature which wants them we call defective, ill-constituted, a kind of abortion. But the *public* affections we esteem as self-worthy, originally and eternally amiable.

57 Distinction between vehement and calm affections.

But among the *social* affections we make an obvious and constant distinction, viz. between those particular passions which urge us with a sudden violence, and uneasy kind of sensation, to pursue the good of their respective objects, as *pity*, *natural affection*, and the like; and those calm dispassionate affections and desires which prompt us more steadily and uniformly to promote the happiness of others. The former we generally call *passions*, to distinguish them from the other sort, which go more commonly by the name of *affections*, or *calm desires*. The first kind we approve indeed, and delight in; but we feel still higher degrees of approbation and moral complacence towards the *last*, and towards all limitation of the particular instincts, by the principle of *universal benevolence*. The more objects the calm affections take in, and the worthier these are, their dig-

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nity rises in proportion, and with this our approbation keeps an exact pace. A character, on the other hand, which is quite divested of these public affections, which feels no love for the species, but instead of it entertains malice, rancour, and ill will, we reckon totally immoral and unnatural.

Such then are the sentiments and dispositions we feel when these several orders of affections pass before the mental eye.

Therefore, "that state in which we feel ourselves moved, in the manner above described, towards those affections and passions, as they come under the mind's review, and in which we are, instantaneously and independently of our choice or volition, prompted to a *correspondent* conduct, we call a state of *moral obligation*." Let us suppose, for instance, a parent, a friend, a benefactor, reduced to a condition of the utmost indigence and distress, and that it is in our power to give them immediate relief. To what conduct are we *obliged*? what *duty* does nature dictate and require in such a case? Attend to nature, and nature will tell, with a voice irresistibly audible and commanding to the *human heart*, with an authority which no man can silence without being self-condemned, and which no man can elude but at his peril, "that immediate relief *ought* to be given." Again, Let a friend, a neighbour, or even a stranger, have lodged a *deposite* in our hands, and after some time reclaim it; no sooner do these ideas of the confidence reposed in us, and of property not *transferred*, but *deposited*, occur, than we immediately and unavoidably feel and recognize the *obligation* to restore it. In both these cases we should condemn and even loathe ourselves if we acted otherwise, as having done, or omitted doing, what we *ought* not, as having acted beneath the dignity of our nature;—contrary to our most intimate sense of *right* and *wrong*:—we should accuse ourselves as guilty of ingratitude, injustice, and inhumanity,—and be conscious of deserving the censure, and therefore dread the resentment, of all rational beings.—But in complying with the *obligation*, we feel joy and self-approbation,—are conscious of an inviolable harmony between our nature and duty, and think ourselves entitled to the applause of every impartial spectator of our conduct.

58 Moral obligation.

To *describe*, therefore, what we cannot perhaps *define*, a state of *moral obligation* is "that state in which a creature, endued with such senses, powers, and affections as man, would condemn himself, and think he deserved the condemnation of all others, should he refuse to fulfil it; but would approve himself, and expect the approbation of all others, upon complying with it."

59 Moral agent.

And we call him a MORAL AGENT, who is in such a *state*, or is subject to *moral obligation*. Therefore, as man's *structure* and *connexions* often subject him to such a state of *moral obligation*, we conclude that *he* is a *moral agent*. But as man may sometimes act without *knowing* what he does, as in cases of *frenzy* or *disease*, or in many *natural functions*; or, knowing what he does, he may act without *choice* or *affection*, as in cases of *necessity* or *compulsion*; therefore, to denominate an action *moral*, i. e. *approvable*, or *blameable*, it must be done *knowingly* and *willingly*, or *from affection* and *choice*. "A *morally good action*, then, is to fulfil a *moral obligation* knowingly and willingly." And a *morally bad action*, or an *immoral action*, is, "to violate a *moral obligation* knowingly and willingly."

60 Moral action good and bad.

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As not an *action*, but a *series of actions*, constitute a *character*; as not an *affection*, but a *series of affections*, constitute a *temper*; and as we denominate things by the gross, *à fortiori*, or by the qualities which chiefly prevail in them; therefore we call that a "*morally good character*, in which a *series of morally good actions* prevail;" and that a "*morally good temper*, in which a *series of morally good affections* have the ascendant." A bad character and bad temper are the reverse. But where the above-mentioned *order* or *proportion* of passions is maintained, there a *series* of *morally* good *affections and actions* will prevail. *Therefore*, "to maintain that order and proportion, is to have a *morally good temper and character*." But a "morally good temper and character is *moral rectitude*, *integrity*, *virtue*, or the *completion of duty*."

61 Moral character and temper good and bad.

62 How we come by the idea of moral obligation.

If it be asked, after all, "how we come by the idea of *moral obligation* or *duty*?" we may answer, That we come by it in the same way as by our other *original* and *primary* perceptions. We receive them all from nature, or the great Author of nature. For this idea of *moral obligation* is not a creature of the mind, or dependent on any previous act of volition; but arises on certain occasions, or when certain other ideas are presented to the mind, as necessarily, instantaneously, and unavoidably, as *pain* does upon too near an approach to the fire, or *pleasure* from the fruition of any good. It does not, for instance, depend on our choice, whether we shall feel the *obligation* to succour a distressed parent, or to restore a deposite intrusted to us when it is recalled. We cannot call this a *compound idea* made up of one or more simple ideas. We may indeed, nay we must, have some ideas antecedent to it, e. g. that of a parent in distress—of a child—able to relieve—of the relation of one to the other—of a trust—of right, &c. But none of these ideas constitute the perception of *obligation*. This is an idea quite distinct from, and something superadded to, the ideas of the correlatives, or the relation subsisting between them. These indeed, by a law of our nature, are the occasion of suggesting it; but they are as totally different from it as colours are from sounds. By sense of reflection we perceive the correlatives; our memory reveals the favours or deposite we received; the various circumstances of the case are matters of fact or experience; but some delicate inward *organ* or *power*, or call it what we please, does, by a certain instantaneous sympathy, antecedent to the cool deductions of reason, and independent of previous instruction, or volition, *perceive the moral harmony*, the *living*, *irresistible charms of moral obligation*, which immediately interests the correspondent passions, and prompts us to fulfil its lawful dictates.

63 The use of reason in moral cases.

We need not apprehend any danger from the quickness of its decisions, nor be frightened because it looks like *instinct*, and has been called so. Would we approve one for deliberating long, or reasoning the matter much at leisure, whether he should relieve a distressed parent, feed a starving neighbour, or restore the trust committed to him? should we not suspect the reasoner of knavery, or of very weak affections to virtue? We employ *reason*, and worthily employ it, in examining the condition, relations, and other circumstances of the agent or patient, or of those with whom

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whom either of them are connected, or, in other words, the *state of the case:* and in complicated cases, where the circumstances are many, it may require no small attention to find the true state of the case; but when the relations of the agent or patient, and the circumstances of the action are obvious, or come out such after a fair trial, we should scarcely approve him who demurs on the obligation to that conduct which the case suggests.

64 Pleasure not the idea of obligation.

From what has been said, it is evident, that it is not the pleasure or agreeable sensations, which accompany the exercise of the several affections, nor those consequent to the actions, that constitute *moral obligation*, or excite in us the idea of it. That pleasure is posterior to the idea of obligation; and frequently we are obliged, and acknowledge ourselves under an obligation, to such affections and actions as are attended with pain; as in the trials of virtue, where we are obliged to sacrifice private to public good, or a present pleasure to a future interest. We have pleasure in serving an aged parent, but it is neither the perception nor prospect of that pleasure which gives us the idea of obligation to that conduct.

CHAP. III. *The* FINAL *Causes of our moral Faculties of* PERCEPTION *and* AFFECTION.

65 The survey proposed.

WE have now taken a *general* prospect of MAN and of his *moral powers* and *connexions*, and on these erected a scheme of *duty* or *moral obligation*, which seems to be confirmed by *experience*, consonant to *reason*, and approved by his most inward and most sacred *senses*. It may be proper, in the next place, to take a more particular view of the *final causes* of those delicate *springs* by which he is *impelled* to action, and of those *clogs* by which he is restrained from it. By this detail we shall be able to judge of their aptitude to answer their end, in a creature endued with his *capacities*, subject to his *wants*, exposed to his *dangers*, and susceptible of his *enjoyments;* and from thence we shall be in a condition to pronounce concerning the *end* of his *whole structure*, its *harmony* with its *state*, and consequently its subserviency to answer the great and benevolent intentions of its Author.

66 Inward anatomy of the system of the mind.

The supreme Being has seen fit to blend in the whole of things a prodigious variety of discordant and contrary principles, *light* and *darkness*, *pleasure* and *pain*, *good* and *evil*. There are multifarious natures, *higher* and *lower*, and many intermediate ones between the wide-distant extremes. These are differently situated, variously adjusted, and subjected to each other, and all of them subordinate to the order and perfection of the whole. We may suppose *man* placed as in a centre amidst those innumerable orders of beings, by his *outward* frame drawing to the *material* system, and by his *inward* connected with the INTELLECTUAL or *moral*, and of course affected by the laws which govern both, or affected by that good and that ill which result from those laws. In this infinite variety of *relations* with which he is surrounded, and of *contingencies* to which he is liable, he feels strong attractions to the *good*, and violent repulsions or aversions to the *ill*. But as good and ill are often blended, and wonderfully complicated one with the other; as they sometimes immediately produce and run up into each other, and at other times lie at great distances, yet by means of intervening links introduce one another; and as these effects are often brought about in consequence of hidden relations and general laws, of the energy of which he is an incompetent judge; it is easy for him to mistake *good* for *evil*, and *evil* for *good*, and consequently he may be frequently attracted by such things as are destructive or repel such as are salutary. Thus, by the tender and complicated frame of his body, he is subjected to a great variety of ills, to *sickness*, *cold*, *heat*, *fatigue*, and innumerable *wants*. Yet his knowledge is so narrow withal, and his reason so weak, that in many cases he cannot judge, in the way of investigation or reasoning, of the connexions of those effects with their respective causes, or of the various latent energies of natural things. He is therefore informed of this connexion by the experience of certain *senses* or *organs* of *perception*, which by a mechanical instantaneous motion, feel the *good* and the *ill*, receiving pleasure from *one*, and pain from the *other*. By these, without any reasoning, he is taught to attract or choose what tends to his welfare, and to repel and avoid what tends to his ruin. Thus, by his senses of *taste* and *smell*, or by the *pleasure* he receives from certain kinds of food, he is admonished which agree with his constitution; and by an opposite sense of *pain* he is informed which sort disagree, or are destructive of it; but is not by means of this instructed in the inward natures and constitutions of things.

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67 Use of appetites and passions.

Some of those senses are armed with strong degrees of *uneasiness* or *pain*, in order to urge him to seek after such objects as are suited to them. And these respect his more immediate and pressing *wants;* as the sense of *hunger*, *thirst*, *cold*, and the like; which, by their painful importunities, compel him to provide *food*, *drink*, *raiment*, *shelter*. Those instincts by which we are thus prompted with some kind of commotion or violence to attract and pursue *good*, or to repel and avoid *ill*, we call *appetites* and *passions*. By our senses then we are informed of what is *good* or *ill* to the *private system*, or the *individual;* and by our *private appetites* and *passions* we are impelled to one, and restrained from the other.

68 Man's outward state.

In consequence of this machinery, and the great train of wants to which our nature subjects us, we are engaged in a continued series of occupations, which often require much application of thought, or great bodily labour, or both. The necessaries of life, food, clothes, shelter, and the like, must be provided; conveniencies must be acquired to render life still more easy and comfortable. In order to obtain these, arts, industry, manufactures, and trade are necessary. And to secure to us the peaceable enjoyment of their fruits, civil government, policy, and laws, must be contrived, and the various business of public life carried on: thus, while man is concerned and busied in making provision, or obtaining security for himself, he is by degrees engaged in connexions with a family, friends, neighbours, a community, or a commonwealth. Hence arise new wants, new interests, new cares, and new employments. The passions of one man interfere with those of another. Interests are opposed. Competitions arise, contrary courses are taken. Disappointments happen, distinctions are made, and parties formed. This opens a vast

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scene of distraction and embarrassment, and introduces a mighty train of good and ill, both public and private. Yet amidst all this confusion and hurry, plans of action must be laid, consequences foreseen or guarded against, inconveniences provided for; and frequently particular resolutions must be taken, and schemes executed, without reasoning or delay.

69 Provisions for it.

Now what provision has the Author of our nature made for this necessitous condition? how has he fitted the actor, man, for playing his part in this perplexed and busy scene?

70 By public senses and passions.

Our supreme Parent, watchful for the whole, has not left himself without a witness here neither, and hath made nothing imperfect, but all things are double one against the other. He has not left man to be informed, only by the cool notices of reason, of the *good* or *ill*, the *happiness* or *misery* of his fellow creatures.—He has made him sensible of their good and happiness, but especially of their ill and misery, by an immediate sympathy, or quick *feeling* of *pleasure* and of *pain*.

71 Pity.

The latter we call PITY or COMPASSION. For the former, though every one, who is not quite divested of humanity, feels it in some degree, we have not got a name, unless we call it CONGRATULATION or *joyful* SYMPATHY, or that *good humour* which arises on seeing others pleased or happy. Both these feelings have been called in general the PUBLIC or COMMON SENSE, κοινη μηνιοσυνη, by which we feel for others, and are interested in their concerns as really, though perhaps less sensibly, than in our own.

72 Congratulation.

73 Resentment.

When we see our fellow creatures unhappy through the fault or injury of others, we feel *resentment* or *indignation* against the *unjust* causers of that misery.—If we are conscious that it has happened through our fault or *injurious* conduct, we feel *shame*; and both these classes of *senses* and *passions*, regarding *misery* and *wrong*, are armed with such sharp sensations of *pain*, as not only prove a powerful guard and security to the *species*, or *public system*, against those ills it may, but serve also to lessen or remove those ills it does, suffer. Compassion draws us out of ourselves to bear a part of the misfortunes of others, powerfully solicits us in their favour, melts us at the sight of their distress, and makes us in some degree unhappy till they are relieved from it. It is peculiarly well adapted to the condition of human life, because it is much more and oftener in our power to do mischief than good, and to prevent or lessen misery than to communicate positive happiness; and therefore it is an admirable restraint upon the more *selfish* passions, or those violent impulses that carry us to the hurt of others.

74 Public affections.

There are other particular *instincts* or *passions* which interest us in the concerns of others, even while we are most busy about our own, and which are strongly attractive of *good*, and repulsive of *ill* to them. Such are *natural affection*, *friendship*, *love*, *gratitude*, *desire of fame*, *love of society*, of *one's country*, and others that might be named. Now as the *private* appetites and passions were found to be armed with strong sensations of desire and uneasiness, to prompt man the more effectually to sustain labours, and to encounter dangers in pursuit of those goods that are necessary to the preservation and welfare of the individual, and to avoid those ills which tend to his destruction; in like manner it was necessary, that this *other* class of desires and affections should be prompted with as quick sensations of pain, not only to counteract the strength of their antagonists, but to engage us in a virtuous activity for our relations, families, friends, neighbours, country. Indeed our *sense* of *right* and *wrong* will admonish us that it is our *duty*, and *reason* and *experience* farther assure us that it is both our *interest* and best *security*, to promote the happiness of others; but that *sense*, that *reason*, and that *experience*, would frequently prove but weak and ineffectual prompters to such a conduct, especially in cases of danger and hardship, and amidst all the importunities of nature, and that constant hurry in which the *private* passions involve us, without the aid of those particular *kind* affections which mark out to us particular spheres of duty, and with an agreeable violence engage and fix us down to them.

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75 Contrast or balance of passions.

It is evident, therefore, that those two classes of affection, the *private* and *public*, are set one against the other, and designed to controul and limit each other's influence, and thereby to produce a just balance in the whole *. In general, the violent sensations of pain and uneasiness which accompany hunger, thirst, and the other private appetites, or too great fatigue of mind as well as of body, prevent the individual from running to great excesses in the exercise of the higher functions of the mind, as too intense thought in the search of truth, violent application to business of any kind, and different degrees of romantic heroism. On the other hand, the finer senses of *perception*, and those *generous desires* and *affections* which are connected with them, the *love of action*, of *imitation*, of *truth*, *honour*, *public virtue*, and the like, are wisely placed in the opposite scale, in order to prevent us from sinking into the dregs of the *animal* life, and debasing the dignity of man below the condition of brutes. So that, by the mutual reaction of those opposite powers, the bad effects are prevented that would naturally result from their acting singly and apart, and the good effects are produced which each are severally formed to produce.

* Vid. *Hutcheson's Conduct of the Passions*, Treat. 1. § 2.

76 Contrast or balance of public and private passions.

The same wholesome opposition appears likewise in the particular counter-workings of the *private* and *public* affections one against the other. Thus *compassion* is adapted to counterpoise the *love of ease*, of *pleasure*, and of *life*, and to disarm or to set bounds to *resentment*; and *resentment* of injury done to ourselves, or to our friends who are dearer than ourselves, prevents an effeminate *compassion* or *consternation*, and gives us a noble contempt of labour, pain, and death. *Natural affection*, *friendship*, *love of one's country*, nay *zeal* for any particular virtue, are frequently more than a match for the whole train of *selfish* passions, —On the other hand, without that intimate overruling passion of *self-love*, and those private desires which are connected with it, the *social* and *tender instincts* of the human heart would degenerate into the wildest dotage, the most torturing anxiety, and downright frenzy.

77 Contrasts among those of the same classes.

But not only are the different orders or classes of affection checks one upon another, but passions of the same classes are mutual clogs. Thus, how many are withheld from the violent outrages of *resentment* by *fear!* and how easily is *fear* controlled in its turn, while mighty wrongs awaken a mighty *resentment!*

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The *private* passions often interfere, and therefore moderate the violence of each other; and a calm *self-love* is placed at their head, to direct, influence, and controul their particular attractions and repulsions. The *public* affections likewise restrain one another; and all of them are put under the controul of a calm dispassionate *benevolence*, which ought in like manner to direct and limit their particular motions. Thus most part, if not all the passions, have a twofold aspect, and serve a twefold end. In *one* view they may be considered as *powers*, impelling mankind to a certain course, with a *force* proportioned to the *apprehended moment* of the good they aim at. In *another* view they appear as *weights*, balancing the action of the *powers*, and controlling the violence of their impulses. By means of these *powers* and *weights* a natural *poise* is settled in the human breast by its all-wise Author, by which the creature is kept tolerably steady and regular in his course, amidst that variety of stages through which he must pass.

78 Particular perceptions or instincts of approbation.

But this is not all the provision which God has made for the hurry and perplexity of the scene in which man is destined to act. Amidst those infinite attractions and repulsions towards private and public good and ill, mankind either cannot often foresee the *consequences* or *tendencies* of all their actions towards one or other of these, especially where those tendencies are intricate and point different ways, or those consequences remote and complicated; or though, by careful and cool inquiry, and a due improvement of their rational powers, they might find them out, yet, distracted as they are with business, amused with trifles, dissipated by pleasure, and disturbed by passion, they either have or can find no leisure to attend to those consequences, or to examine how far this or that conduct is productive of private or public good on the whole. Therefore, were it left entirely to the slow and sober deductions of reason to trace those tendencies, and make out those consequences, it is evident, that in many particular instances the business of life must stand still, and many important occasions of action be lost, or perhaps the grossest blunders be committed. On this account, the Deity, besides that general approbation which we bestow on every degree of *kind* affection, has moreover implanted in man many particular *perceptions* or *determinations* to approve of certain *qualities* or *actions*, which, in effect, tend to the advantage of society, and are connected with private good, though he does not always see that tendency, nor mind that connexion. And these *perceptions* or *determinations* do, without reasoning, point out, and, antecedent to views of interest, prompt to a conduct beneficial to the *public*, and useful to the *private* system. Such is that *sense of candour and veracity*, that *abhorrence of fraud and falsehood*, that *sense of fidelity, justice, gratitude, greatness of mind, fortitude, clemency, decorum*, and that *disapprobation of knavery, injustice, ingratitude, meanness of spirit, cowardice, cruelty*, and *indecorum*, which are natural to the human mind. The *former* of those dispositions, and the actions flowing from them, are approved, and those of the latter kind disapproved by us, even abstracted from the view of their tendency or conduciveness, to the happiness or misery of others, or of ourselves. In one we discern a *beauty*, a *superior excellency*, a congruity to the *dignity* of man; in the other a *deformity*, a *littleness*, a *debasement*, of human nature.

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79 Others of an inferior order.

There are other principles also connected with the good of society, or the happiness and perfection of the individual, though that connexion is not immediately apparent, which we behold with real complacency and approbation, though perhaps inferior in degree, if not in kind, such as *gravity, modesty, simplicity of deportment, temperance, prudent economy;* and we feel some degree of contempt and dislike where they are wanting, or where the opposite qualities prevail. These and the like *perceptions* or *feelings* are either different *modifications* of the *moral sense*, or *subordinate* to it, and plainly serve the same important purpose, being expeditious *monitors*, in the several emergencies of a various and distracted life, of what is *right*, what is *wrong*, what is to be *pursued*, and what *avoided;* and, by the pleasant or painful consequences which attend them, exerting their influence as powerful *prompters* to a suitable conduct.

80 Their general tendencies.

From a slight inspection of the above-named principles, it is evident they all carry a friendly aspect to *society* and the *individual*, and have a more immediate or a more remote tendency to promote the *perfection* or *good* of both. This tendency cannot be always foreseen, and would be often mistaken, or seldom attended to by a weak, busy, short-sighted creature like man, both rash and variable in his opinions, a dupe to his own passions, or to the designs of others, liable to sickness, to want, and to error. Principles, therefore, which are so nearly linked with *private security* and *public good*, by directing him, without operose reasoning, where to find the *one*, and how to promote the *other;* and, by prompting him to a conduct conducive to both, are admirably adapted to the exigencies of his present state, and wisely calculated to obtain the ends of universal benevolence.

81 Passions fitted to a state of trial.

It were easy, by considering the subject in another light, to show, in a curious detail of particulars, how wonderfully the inside of man, or that astonishing train of *moral powers* and *affections* with which he is endued, is fitted to the several stages of that *progressive* and *probationary* state through which he is destined to pass. As our faculties are narrow and limited, and rise from very small and imperfect beginnings, they must be improved by exercise, by attention, and repeated trials. And this holds true not only of our *intellectual* but of our *moral* and *active* powers. The former are liable to errors in speculation, the latter to blunders in practice, and both often terminate in misfortunes and pains. And those errors and blunders are generally owing to our passions, or to our too forward and warm *admiration* of those partial *goods* they naturally pursue, or to our fear of those partial *ills* they naturally repel. Those misfortunes, therefore, lead us back to consider where our misconduct lay, and whence our errors flowed; and consequently are salutary pieces of trial, which tend to enlarge our views, to *correct* and *refine* our passions, and consequently improve both our *intellectual* and *moral* powers. Our passions then are the rude materials of our virtue, which Heaven has given us to work up, to refine and polish into a harmonious and divine piece of workmanship. They furnish out the whole machinery, the calms and storms, the lights and shades of human life. They show mankind in every attitude

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attitude and variety of character, and give *virtue* both its struggles and its triumphs. To conduct them well in every state, is merit; to abuse or misapply them, is demerit.

82 To a progressive state.

The different sets of *senses*, *powers*, and *passions*, which unfold themselves in those successive stages, are both necessary and adapted to that *rising* and *progressive* state. Enlarging views and growing connexions require new passions and new habits; and thus the mind, by these continually expanding and finding a progressive exercise, rises to higher improvements, and pushes forward to maturity and perfection.

83 Harmony of our structure and state.

In this beautiful economy and harmony of our structure, both outward and inward, with that state, we may at once discern the great lines of our duty traced out in the fairest and brightest characters, and contemplate with admiration a more august and marvellous scene of divine wisdom and goodness laid in the human breast, than we shall perhaps find in the whole compass of nature.

From this detail it appears, that man, by his original frame, is made for a *temperate*, *compassionate*, *benevolent*, *active*, and *progressive* state. He is strongly *attractive* of the *good*, and *repulsive* of the *ills* which befal others as well as himself. He feels the highest *approbation* and *moral complacence* in those affections, and in those actions, which immediately and directly respect the *good* of others, and the highest *disapprobation*, and *abhorrence* of the contrary. Besides these, he has many particular *perceptions* or *instincts* of *approbation*, which, though perhaps not of the same kind with the others, yet are accompanied with correspondent degrees of affection, proportioned to their respective tendencies to the *public good*. *Therefore*, by acting agreeably to these principles, *man* acts agreeably to his structure, and fulfils the benevolent intentions of its Author. But we call a thing *good* when it answers its *end*, and a creature *good*, when he acts in a *conformity* to his *constitution*. Consequently, *man* must be denominated *good* or *virtuous* when he acts suitably to the *principles* and *destination* of his nature.

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84 In what economy virtue consists.

PART II.

Chap. I. *The principal Distinctions of* Duty *or* Virtue.

WE have now considered the *constitution* and *connexions* of *man*, and on those erected a general system of *duty* or *moral obligation*, consonant to *reason*, approved by his most sacred and intimate *sense*, suitable to his *mixed condition*, and confirmed by the *experience* of mankind. We have also traced the *final causes* of his *moral faculties* and *affections* to those noble purposes they answer, with regard both to the *private* and the *public system*.

85 General division of duty.

From this induction it is evident, that there is one order or class of duties which *man* owes to *himself*: another to *society*: and a third to *God*.

86 Duty to one's self.

The duties he owes to *himself* are founded chiefly on the *defensive* and *private* passions, which prompt him to pursue whatever tends to *private good* or *happiness*, and to avoid or ward off whatever tends to *private ill* or *misery*. Among the various goods which allure and solicit him, and the various ills which attack or threaten him, "to be intelligent and accurate in selecting *one*, and rejecting the *other*, or in preferring the most *excellent goods*, and avoiding the most *terrible ills*, when there is a competition among either, and to be discreet in using the best means to attain the *goods* and avoid the *ills*, is what we call *prudence*. This, in our *inward* frame, corresponds to *sagacity*, or *quickness of sense*, in our *outward*.—"To proportion our *defensive passions* to our *dangers*, we call *fortitude*; which always implies "a just mixture of calm resentment or animosity, and well-governed caution." And this *firmness of mind* answers to the *strength* and *muscling* of the *body*. And "duly to adjust our *private passions* to our wants, or to the respective moment of the good we affect or pursue, we call *temperance*; which does therefore always imply, in this large sense of the word, "a just balance or command of the passions."

87 Duties to society.

The *second class* of *duties* arises from the *public* or *social affections*, "the just harmony or proportion of which to the *dangers* and *wants* of others, and to the several *relations* we bear, commonly goes by the name of *justice*." This includes the whole of our duty to *society*, to our *parents*, and the *general polity* of *nature*; particularly *gratitude*, *friendship*, *sincerity*, *natural affection*, *benevolence*, and the other *social virtues*: This, being the *noblest temper*, and *fairest complexion* of the soul, corresponds to the *beauty* and *fine proportion* of the person. The virtues comprehended under the former class, especially *prudence* and *fortitude*, may likewise be transferred to this; and according to the various circumstances in which they are placed, and the more confined or more extensive sphere in which they operate, may be denominated *private*, *economical*, or *civil prudence*, *fortitude*, &c. These direct our conduct with regard to the *wants* and *dangers* of those lesser or greater circles with which they are connected.

88 Duties to God.

The *third* class of duties respects the Deity, and arises from the *public affections*, and the several glorious *relations*, which he sustains to us as our *Creator*, *Benefactor*, *Lawgiver*, *Judge*, &c.

89 Method.

We choose to consider this *set* of duties in the last place; because, though *prior* in dignity and excellency, they seem to be *last* in order of time, as thinking it the most simple and easy method to follow the gradual progress of nature, as it takes its rise from individuals, and spreads through the social system, and still ascends upwards, till at length it stretches to its almighty Parent and Head, and so terminates in those duties which are *highest* and *best*.

90 Piety.

The duties resulting from these *relations*, are *reverence*, *gratitude*, *love*, *resignation*, *dependence*, *obedience*, *worship*, *praise*: which, according to the model of our fine capacities, must maintain some sort of proportion to the grandeur and perfection of the object whom we venerate, love, and obey. "This *proportion* or *harmony* is expressed by the general name of *piety* or *devotion*,"

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devotion," which is always stronger or weaker according to the greater or less apprehended excellency of its object. This sublime principle of virtue is the enlivening soul which animates the *moral system*, and that cement which binds and sustains the other duties which *man* owes to *himself* or to *society*.

91 Conscience.

This then is the general temper and constitution of virtue, and these are the principal lines or divisions of duty. To those good dispositions which respect the several objects of our duty, and to all actions which flow from such dispositions, the mind gives its sanction or testimony. And this sanction or judgment concerning the moral quality, or the goodness of actions or dispositions, moralists call *conscience*. When it judges of an action that is to be performed, it is called an *antecedent conscience;* and when it passes sentence on an action which is performed, it is called a *subsequent conscience*. The tendency of an action to produce happiness, or its external conformity to a law, is termed its *material* goodness. But the good dispositions from which an action proceeds, or its conformity to law in every respect, constitutes its *formal* goodness.

92 Its divisions.

When the mind is ignorant or uncertain about the moment of an action or its tendency to private or public good; or when there are several circumstances in the case, some of which, being doubtful, render the mind dubious concerning the morality of the action; that is called a *doubtful* or *scrupulous conscience;* if it mistakes concerning these, it is called an *erroneous conscience*. If the *error* or *ignorance* is *involuntary* or *invincible*, the action proceeding from that *error*, or from that *ignorance*, is reckoned *innocent*, or not imputable. If the error or ignorance is *supine* or *affected*, i. e. the effect of negligence, or of affectation and wilful inadvertence, the conduct flowing from such error, or such ignorance, is *criminal* and *imputable*.—Not to follow one's conscience, though erroneous and ill-informed, is *criminal*, as it is the guide of life; and to counteract it, shows a depraved and incorrigible spirit. Yet to follow an erroneous conscience is likewise criminal, if that error which misled the conscience was the effect of inattention, or any criminal passion *.

* *Hutchs. Moral Inst.* lib. ii. c. 5.

93 How conscience is to be rectified

If it be asked, "How an erroneous conscience shall be rectified, since it is supposed to be the only guide of life, and judge of morals? we answer, In the very same way that we would rectify reason if at any time it should judge wrong, as it often does, viz. by giving it proper and sufficient materials for judging right, i. e. by inquiring into the whole state of the case, the relations, connexions, and several obligations of the actor, the consequences and other circumstances of the action, or the surplusage of private or public good which results, or is likely to result, from the action or from the omission of it. If those circumstances are fairly and fully stated, the conscience will be just and impartial in its decision; for, by a necessary law of our nature, it approves and is well affected to the *moral form;* and if it seems to approve of *vice* or *immorality*, it is always under the notion or mask of some *virtue*. So that, strictly speaking, it is not conscience which errs; for its sentence is always conformable to the view of the case which lies before it; and is *just*, upon the supposition that the case is truly such as it is represented to it. All the fault is to be imputed to the agent, who neglects to be better informed, or who, through weakness or wickedness, hastens to pass sentence from an imperfect evidence.

Of Man's duty to Himself.

Chap. II. *Of Man's Duty to* Himself. *Of the Nature of* Good, *and the Chief* Good.

94 Divisions of good.

Every creature, by the constitution of his nature is determined to love himself; to pursue whatever tends to his preservation and happiness, and to avoid whatever tends to his hurt and misery. Being endued with sense and perception, he must necessarily receive *pleasure* from some objects, and *pain* from others. Those objects which give pleasure are called *good;* and those which give pain, *evil*. To the former he feels that attraction or motion we call *desire* or *love;* to the latter, that impulse we call *aversion* or *hatred*.—To objects which suggest neither pleasure nor pain, and are apprehended of no use to procure one or ward off the other, we feel neither *desire* nor *aversion;* and such objects are called *indifferent*. Those objects which do not of themselves produce pleasure or pain, but are the *means* of procuring either, we call *useful* or *noxious*. Towards them we are affected in a subordinate manner, or with an *indirect* and *reflective* rather than a *direct* and *immediate* affection. All the original and particular affections of our nature lead us out to and ultimately rest in the first kind of objects, viz. those which give immediate pleasure, and which we therefore call *good directly so*. The calm affection of *self-love* alone is conversanta bout such objects as are only *consequentially good*, or merely useful to ourselves.

95 Moral good.

But, besides those sorts of objects which we call *good*, merely and solely as they give pleasure, or are means of procuring it, there is a higher and nobler species of good, towards which we feel that peculiar movement we call *approbation* or *moral complacency;* and which we *therefore* denominate *moral good*. Such are our affections, and the consequent actions to them. The perception of this is, as has been already observed, quite distinct in kind from the perception of other species; and though it may be connected with *pleasure* or *advantage* by the benevolent constitution of nature, yet it constitutes a *good* independent of that pleasure and that advantage, and far superior not in degree only but in dignity to both. The *other*, viz. the *natural good*, consists in obtaining those pleasures which are adapted to the peculiar senses and passions, susceptible of them, and is as various as are those senses and passions. This, *viz.* the *moral* good, lies in the right conduct of the several senses and passions, or their just proportion and accommodation to their respective objects and relations, and this is of a more simple and invariable kind.

96 Human happiness.

By our several senses we are capable of a great variety of pleasing sensations. These constitute distinct ends or objects ultimately pursuable for their own sake. To these ends, or ultimate objects, correspond peculiar appetites or affections, which prompt the mind to pursue them. When these ends are attained, there it rests, and looks no farther. Whatever therefore is pursuable, not on its own account, but as subservient or necessary to the attainment of something else that is intrinsically valuable for its own sake, be that value ever so great or ever so small, we call a

mean,

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mean, and not an *end*. So that *ends* and *means* constitute the *materials* or the very *essence* of our *happiness*. Consequently happiness, *i. e. human* happiness, cannot be one simple uniform thing in creatures constituted as we are, with such various senses of pleasure, or such different capacities of enjoyment. Now the same principle, or law of our nature, which determines us to pursue any one end or species of good, prompts us to pursue every other end or species of good of which we are susceptible, or to which our Maker has adapted an original propension. But amidst the great multiplicity of *ends* or *goods* which form the various ingredients of our happiness, we perceive an evident *gradation* or *subordination* suited to that gradation of *senses*, *powers*, and *passions*, which prevails in our mixed and various constitution, and to that ascending series of connexions which open upon us in the different stages of our progressive state.

97 Gradation of goods.

Thus the goods of the *body*, or of the *external senses*, seem to hold the lowest rank in this gradation or scale of goods. These we have in common with the brutes; and though many men are brutish enough to pursue the goods of the body with a more than brutal fury, yet, when at any time they come in competition with goods of an higher order, the unanimous verdict of mankind, by giving the last the preference, condemns the first to the meanest place. Goods consisting in exterior social connexions, as *fame*, *fortune*, *power*, *civil authority*, seem to succeed next, and are chiefly valuable as the means of procuring *natural* or *moral* good, but principally the latter. Goods of the *intellect* are still superior, as *taste*, *knowledge*, *memory*, *judgment*, &c. The highest are moral goods of the mind, directly and ultimately regarding ourselves, as *command of the appetites* and *passions*, *prudence*, *fortitude*, *benevolence*, &c. These are the great objects of our pursuit, and the principal ingredients of our happiness. Let us consider each of them as they rise one above the other in this natural series or scale, and touch briefly on our obligations to pursue them.

98 Goods of the body.

Those of the bodly are *health*, *strength*, *agility*, *hardiness*, and *patience of change*, *neatness*, and *decency*.

99 Good health;

Good health, and a regular easy flow of spirits, are in themselves sweet natural enjoyments, a great fund of pleasure, and indeed the proper seasoning which gives a flavour and poignancy to every other pleasure. The want of health unfits us for most duties of life, and is especially an enemy to the social and humane affections, as it generally renders the unhappy sufferer peevish and sullen, disgusted at the allotments of Providence, and consequently apt to entertain suspicious and gloomy sentiments of its Author. It obstructs the free exercise and full improvement of our reason, makes us a burden to our friends, and useless to society. Whereas the uninterrupted enjoyment of good health is a constant source of good humour, and good humour is a great friend to openness and benignity of heart, enables us to encounter the various ills and disappointments of life with more courage, or to sustain them with more patience; and, in short, conduces much, if we are otherwise duly qualified, to our acting our part in every exigency of life with more firmness, consistency, and dignity. Therefore it imports us much to preserve and improve a habit or enjoyment, without which every other external entertainment is tasteless, and most other advantages of little avail.— And this is best done by a strict temperance in diet and regimen, by regular exercise, and by keeping the mind serene and unruffled by violent passions, and unsubdued by intense and constant labours, which greatly impair and gradually destroy the strongest constitutions.

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100 How preserved.

101 Strength, agility, &c.

Strength, *agility*, *hardiness*, and *patience of change*, suppose health, and are unattainable without it; but they imply something more, and are necessary to guard it, to give us the perfect use of life and limbs, and to secure us against many otherwise unavoidable ills.— The exercise of the necessary manual, and of most of the elegant arts of life, depends on strength and agility of body; personal dangers, private and public dangers, the demands of our friends, our families, and country, require them; they are necessary in war, and ornamental in peace; fit for the employment of a country and a town life, and they exalt the entertainments and diversions of both. They are chiefly obtained by moderate and regular exercise.

102 How attained.

103 Patience of change;

Few are so much raised above want and dependence, or so exempted from business and care, as not to be often exposed to inequalities and changes of diet, exercise, air, climate, and other irregularities. Now, what can be so effectual to secure one against the mischiefs arising from such unavoidable alterations, as hardiness, and a certain versatility of constitution which can bear extraordinary labours, and submit to great changes, without any sensible uneasiness or bad consequences.

104 How attained.

This is best attained, not by an over great delicacy and minute attention to forms, or by an invariable regularity in diet, hours, and way of living, but rather by a bold and discreet latitude of regimen. Besides, deviations from established rules and forms of living, if kept within the bounds of sobriety and reason, are friendly to thought and original sentiments, animate the dull scene of ordinary life and business, and agreeably stir the passions, which stagnate or breed ill humour in the calms of life.

105 Neatness, decency, &c.

Neatness, *cleanliness*, and *decency*, to which we may add *dignity* of *countenance* and *demeanour*, seem to have something refined and moral in them: at least we generally esteem them indications of an orderly, genteel, and well governed mind, conscious of an inward worth, or the respect due to one's nature. Whereas *nastiness*, *slovenliness*, *awkwardness*, and *indecency*, are shrewd symptoms of something mean, careless, and deficient, and betray a mind untaught, illiberal, unconscious of what is due to one's self or to others. How much cleanliness conduces to health, needs hardly to be mentioned; and how necessary it is to maintain one's character and rank in life, and to render us agreeable to others as well as to ourselves, is as evident.—There are certain motions, airs and gestures, which become the human countenance and form, in which we perceive a *comeliness*, *openness*, *simplicity*, *gracefulness*; and there are others, which to our sense of decorum appear *uncomely*, *affected*, *disingenuous*, and *awkward*, quite unsuitable to the native dignity of our face and form. The *first* are in themselves the most easy, natural and commodious, give one boldness and presence of mind, a modest assurance, an address both awful and alluring; they bespeak candour and great-

ness

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ness of mind, raise the most agreeable prejudices in one's favour, render society engaging, command respect, and often love, and give weight and authority both in conversation and business; in fine, they are the colouring of virtue, which show it to the greatest advantage in whomsoever it is; and not only imitate, but in some measure supply it where it is wanting. Whereas the last, *viz. rudeness*, *affectation*, *indecorum*, and the like, have all the contrary effects; they are burdensome to one's self, a dishonour to our nature, and a nuisance in society. The former qualities or goods

106 How attained.

are best attained by a liberal education, by preserving a just sense of the dignity of our nature, by keeping the best and politest company, but, above all, by acquiring those virtuous and ennobling habits of mind which are decency in perfection, which will give an air of unaffected grandeur, and spread a lustre truly engaging over the whole form and deportment.

107 Goods of exterior social connections.

We are next to consider those goods which consist in exterior social connexions, as *fame*, *fortune*, *civil authority*, *power*.

108 Fame.

The first has a twofold aspect, as a good pleasant in itself, or gratifying to an original passion, and then as expedient or useful towards a farther end. Honour from the wise and good, on the account of a virtuous conduct, is regaling to a good man; for then his heart re-echoes to the grateful sound. There are few quite indifferent even to the commendation of the vulgar. Though we cannot approve that conduct which proceeds entirely from this principle, and not from good affection or love of the conduct itself, yet, as it is often a guard and additional motive to virtue in creatures imperfect as we are, and often distracted by interfering passions, it might be dangerous to suppress it altogether, however wise it may be to restrain it within due bounds, and however laudable to use it only as a scaffolding to our virtue, which may be taken down when that glorious structure is finished, but hardly till then. To pursue fame for itself, is innocent; to regard it only as an auxiliary to virtue, is noble; to seek it chiefly as an engine of public usefulness is still more noble, and highly praise-worthy. For though the opinion and breath of men are transient and fading things, often obtained without merit, and lost without cause; yet as our business is with men, and as our capacity of serving them is generally increased in proportion to their esteem of us, therefore sound and well established *moral* applause may and will be modestly, not ostentatiously, sought after by the *good*; not indeed as a solitary refined sort of luxury, but as a public and proper instrument to serve and bless mankind. At the same time they will learn to despise that reputation which is founded on rank, fortune, and any other circumstances or accomplishments that are foreign to real merit, or to useful services done to others, and think that praise of little avail which is purchased without desert, and bestowed without judgment.

109 Fortune, power, &c.

Fortune, *power*, and *civil authority*, or whatever is called influence and weight among mankind, are *goods* of the *second* division, that is, valuable and pursuable only as they are *useful*, or as means to a farther end, viz. procuring or preserving the immediate objects of enjoyment or happiness to ourselves or others. Therefore to love such goods on their own account, and to pursue them as ends, not the means of enjoyment, must be highly preposterous and absurd. There can be no measure, no limit, to such pursuit; all must be whim, caprice, extravagance. Accordingly, such appetites, unlike all the *natural* ones, are increased by possession, and whetted by enjoyment. They are always precarious, and never without fears, because the objects lie without one's self; they are seldom without sorrow and vexation, because no accession of wealth or

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112 How far pursuable

power can satisfy them. But if those goods are considered only as the materials or means of private or public happiness, then the same obligations which bind us to pursue the latter, bind us likewise to pursue the former. We may, and no doubt we ought, to seek such a measure of wealth as is necessary to supply all our real wants, to raise us above servile dependence, and provide us with such conveniences as are suited to our rank and condition in life. To be regardless of this measure of wealth, is to expose ourselves to all the temptations of poverty and corruption: to forfeit our natural independency and freedom; to degrade, and consequently to render the rank we hold, and the character we sustain in society, useless, if not contemptible. When these important ends are secured, we ought not to murmur or repine that we possess no more; yet we are not secluded by any obligation, moral or divine, from seeking more, in order to give us that happiest and most godlike of all powers, the *power* of *doing good*. A supine indolence in this respect is both absurd and criminal; *absurd*, as it robs us of an inexhausted fund of the most refined and durable enjoyments; and *criminal*, as it renders us so

111 Avarice.

far useless to the society to which we belong. "That pursuit of wealth which goes beyond the former end, viz. the obtaining the necessaries, or such conveniencies of life, as, in the estimation of reason, not of vanity or passion, are suited to our rank and condition, and yet is not directed to the latter, viz. the doing good, is what we call *avarice*." And "that pursuit of *power*, which after securing one's self, i. e. having attained the proper independence and liberty of a rational social creature, is not directed to the good of

113 Ambition.

others, is what we call *ambition*, or the *lust of power*." To what extent the strict measures of virtue will allow us to pursue either wealth or power, and civil authority, is not perhaps possible precisely to determine. That must be left to prudence, and the peculiar character, condition, and other circumstances of each man. Only thus far a limit may be set, that the pursuit of either must encroach upon no other duty or obligation which we owe to ourselves, to society, or to its parent and head. The same reasoning is to be applied to *power* as to *wealth*. It is only valuable as an instrument of our own security, and of the free enjoyment of those original goods it may, and often does, administer to us, and as an engine of more extensive happiness to our friends, our country, and mankind.

113 How fame and power are attained.

Now the best, and indeed the only way to obtain a solid and lasting fame, is an uniform inflexible course of virtue, the employing one's ability and wealth in supplying the wants, and using one's power in promoting or securing the happiness, the rights and liberties of mankind, joined to an universal affability and politeness of manners. And surely one will not mistake the matter much, who thinks the same course conducive to the acquiring greater accessions both of wealth and

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and power; especially if he adds to those qualifications a vigorous industry, a constant attention to the characters and wants of men, to the conjunctures of times, and continually varying genius of affairs; and a steady intrepid honesty, that will neither yield to the allurements, nor be overawed with the terrors, of that corrupt and corrupting scene in which we live. We have sometimes heard indeed of other ways and means, as fraud, dissimulation, servility, and prostitution, and the like ignoble arts, by which the men of the world (as they are called, shrewd politicians, and men of address!) amass wealth, and procure power; but as we want rather to form a man of virtue, an honest, contented, happy man, we leave to the men of the world their own ways, and permit them, unenvied and unimitated by us, to reap the fruit of their doings.

114 Goods of the intellect.

The next species of objects in the scale of good, are the goods of the *intellect*, as *knowledge*, *memory*, *judgement*, *taste*, *sagacity*, *docility*, and whatever else we call intellectual virtues. Let us consider them a little, and the means as well obligations to improve them.

115 Their moment.

As *man* is a *rational* creature, capable of knowing the differences of things and actions;—as he not only sees and feels what is present, but remembers what is past, and often foresees what is future;—as he advances from small beginnings by slow degrees, and with much labour and difficulty, to knowledge and experience;—as his opinions sway his passions,—as his passions influence his conduct,—and as his conduct draws consequences after it, which extend not only to the present but to the future time, and therefore is the principal source of his happiness or misery; it is evident, that he is formed for intellectual improvements, and that it must be of the utmost consequence for him to improve and cultivate his intellectual powers, on which these opinions, those passions, and that conduct depend*.

* *Philos. Sinic. Confuc.* lib. i. § 3, 4, &c.

116 The pleasures they give.

117 Knowledge and taste;

But besides the future consequences and moment of improving our intellectual powers, their immediate exercise on their proper objects yields the most rational and refined pleasures. Knowledge, and a right taste in the arts of *imitation* and *design*, as *poetry*, *painting*, *sculpture*, *music*, *architecture*, afford not only an innocent, but a most sensible and sublime entertainment. By these the understanding is instructed in ancient and modern life, the history of men and things, the energies and effects of the passions, the consequences of virtue and vice; by these the imagination is at once entertained and nourished with the beauties of nature and art, lighted up and spread out with the novelty, grandeur, and harmony of the universe; and, in fine, the passions are agreeably roused, and suitably engaged, by the greatest and most interesting objects that can fill the human mind. He who has a taste formed to those ingenious delights, and plenty of materials to gratify it, can never want the most agreeable exercise and entertainment, nor once have reason to make that fashionable complaint of the tediousness of time. Nor can he want a proper subject for the discipline and improvement of his heart. For, being daily conversant with *beauty*, *order*, and *design*, in inferior subjects, he bids fair for growing in due time an admirer of what is fair and well-proportioned in the conduct of life and the order of society, which is only order and design exerted in their highest subject. He will learn to transfer the numbers of poetry to the harmony of the mind and of well-governed passions; and, from admiring the virtues of others in moral paintings, come to approve and imitate them himself. Therefore, to cultivate a *true* and *correct taste* must be both our interest and our duty, when the circumstances of our station give leisure and opportunity for it, and when the doing it is not inconsistent with our higher obligations or engagements to society and mankind.

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118 How attained.

It is best attained by reading the best books, where *good sense* has more the ascendant than *learning*, and which pertain more to *practice* than to *speculation*; by studying the best models, i. e. those which profess to imitate nature most, and approach the nearest to it, and by conversing with men of the most refined taste, and the greatest experience in life.

119 Other intellectual goods,

As to the other intellectual goods, what a fund of entertainment must it be to investigate the truth and various relations of things, to trace the operations of nature to general laws, to explain by these its manifold phenomena, to understand that order by which the universe is upheld, and that economy by which it is governed! to be acquainted with the human mind, the connexions, subordinations, and uses of its powers, and to mark their energy in life! how agreeable to the ingenious inquirer, to observe the manifold relations and combinations of individual minds in society, to discern the causes why they flourish or decay, and from thence to ascend, through the vast scale of beings, to that general Mind which presides over all; and operates unseen in every system and in every age, through the whole compass and progression of nature! Devoted to such entertainments as these, the contemplative have abandoned every other pleasure, retired from the body, so to speak, and sequestered themselves from social intercourse: for these, the *busy* have often preferred to the hurry and din of life the calm retreats of contemplation; for these, when once they came to taste them, even the *gay* and *voluptuous* have thrown up the lawless pursuits of sense and appetite, and acknowledged these mental enjoyments to be the most *refined*, and indeed the *only* luxury. Besides, by a just and large knowledge of nature, we recognize the perfections of its Author; and thus piety, and all those pious affections which depend on just sentiments of his character, are awakened and confirmed; and a thousand superstitious fears, that arise from partial views of his nature and works, will of course be excluded. An extensive prospect of human life, and of the periods and revolutions of human things, will conduce much to the giving a certain greatness of mind, and a noble contempt to those little competitions about power, honour, and wealth, which disturb and divide the bulk of mankind; and promote a calm endurance of those inconveniencies and ills that are the common appendages of humanity. Add to all, that a just knowlede of human nature, and of those hinges upon which the business and fortunes of men turn, will prevent our thinking either too highly or too meanly of our fellow creatures, give no small scope to the exercise of friendship, confidence, and good will, and at the same time brace the mind with a proper caution and distrust (those nerves of prudence), and give a greater mastery in the conduct of private as well as public life. Therefore, by cultivating our intellectual abilities, we shall best

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best promote and secure our interest, and be qualified for acting our part in society with more honour to ourselves, as well as advantage to mankind. Consequently, to improve them to the utmost of our power is our duty; they are talents committed to us by the Almighty Head of society, and we are accountable to him for the use of them.

120 How attained.

The intellectual virtues are best improved by accurate and impartial observation, extensive reading, and unconfined converse with men of all characters, especially with those who to private study, have joined the widest acquaintance with the world, and greatest practice in affairs; but, above all, by being much in the world, and having large dealings with mankind. Such opportunities contribute much to divest one of prejudices and a servile attachment to crude systems, to open one's views, and to give that experience on which the most useful because the most practical knowledge is built, and from which the surest maxims for the conduct of life are deduced.

121 Moral goods.

The highest goods which enter into the composition of human happiness are *moral* goods of the mind, directly and ultimately regarding ourselves; as *command of the appetites and passions*, *prudence and caution*, *magnanimity*, *fortitude*, *humility*, *love of virtue*, *love of God*, *resignation*, and the like. These sublime goods are goods by way of eminence, goods recommended and enforced by the most intimate and awful sense and consciousness of our nature; goods that constitute the quintessence, the very temper of happiness, and form that complexion of soul which renders us approveable and lovely in the sight of God; goods, in fine, which are the elements of all our future perfection and felicity.

122 Their moment.

Most of the other goods we have considered depend partly on ourselves, and partly on accidents which we can neither foresee nor prevent, and result from causes which we cannot influence or alter. They are such goods as we may possess to-day and lose to-morrow, and which require a felicity of constitution and talents to attain them in full vigour and perfection, and a felicity of conjunctures to secure the possession of them. Therefore, did our happiness depend altogether or chiefly on such transitory and precarious possessions, it were itself most precarious, and the highest folly to be anxious about it. But though creatures, constituted as we are, cannot be indifferent about such goods, and must suffer in some degree, and consequently have our happiness incomplete without them, yet they weigh but little in the scale when compared with moral goods. By the benevolent constitution of our nature, these are placed within the sphere of our activity, so that no man can be destitute of them unless he is first wanting to himself. Some of the wisest and best of mankind have wanted most of the former goods, and all the external kind, and felt most of the opposite ills, such at least as arise from without; yet by possessing the latter, viz. the moral goods, have declared they were happy; and to the conviction of the most impartial observers have appeared happy. The worst of men have been surrounded with every outward good and advantage of fortune, and have possessed great parts; yet for want of moral rectitude, have been, and have confessed themselves, notoriously and exquisitely miserable. The exercise of virtue has supported its votaries, and made them exult in the midst of tortures almost intolerable; nay, how often has some false form or shadow of it sustained even the greatest (E) villains and bigots under the same pressures! But no external goods, no goods of fortune, have been able to alleviate the agonies or expel the fears of a guilty mind, conscious of the deserved hatred and reproach of mankind, and the just displeasure of Almighty God.

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123 The mixed condition of human life requires particular virtues.

As the present condition of human life is wonderfully chequered with good and ill, and as no height of station, no affluence of fortune, can absolutely ensure the good, or secure against the ill, it is evident that a great part of the comfort and serenity of life must lie in having our minds duly affected with regard to both, i. e. rightly attempered to the loss of one and the sufferance of the other. For it is certain that outward calamities derive their chief malignity and pressure from the inward dispositions with which we receive them. By managing these right, we may greatly abate that malignity and pressure, and consequently diminish the number, and weaken the force, of the ills of life, if we should not have it in our power to obtain a large share of its goods. There are particularly three virtues which go to the forming this right temper towards ill, and which are of singular efficacy, if not totally to remove, yet wonderfully to alleviate, the calamities of life. These are *fortitude* or *patience*, *humility*, and *resignation*.

124 Fortitude.

Fortitude is that calm and steady habit of mind which either moderates our fears, and enables us bravely to encounter the prospect of ill, or renders the mind serene and invincible under its immediate pressure. It lies equally distant from rashness and cowardice: and though it does not hinder us from feeling, yet prevents our complaining or shrinking under the stroke. It always includes a generous contempt of, or at least a noble superiority to, those precarious goods of which we can ensure neither the possession nor continuance. The man therefore who possesses this virtue in this ample sense of it, stands upon an eminence, and sees human things below him; the tempest indeed may reach him, but he stands secure and collected against it upon the basis of conscious virtue, which the severest storms can seldom shake, and never overthrow.

125 Humility.

Humility is another virtue of high rank and dignity, though often mistaken for meanness and pusillanimity. It is opposed to *pride*, which commonly includes in it a false or overrated estimation of our own merit, an ascription of it to ourselves as its only and original cause, an undue comparison of ourselves with others, and in consequence of that supposed superiority, an arrogant preference of ourselves, and a supercilious contempt of them. *Humility*, on the other hand, seems to denote that modest and ingenuous temper of mind, which arises from a just and equal

(E) As Ravaillac, who assassinated Henry IV. of France; and Balthasar Gerard, who murdered William I. prince of Orange.

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estimate of our own advantages compared with those of others, and from a sense of our deriving all originally from the Author of our being. Its ordinary attendants are mildness, a gentle forbearance, and an easy unassuming humanity with regard to the imperfections and faults of others; virtues rare indeed, but of the fairest complexion, the proper offspring of so lovely a parent, the best ornaments of such imperfect creatures as we are, precious in the sight of God, and which sweetly allure the hearts of men.

126 Resignation.

Resignation is that mild and heroic temper of mind which arises from a sense of an infinitely wise and good providence, and enables one to acquiesce with a cordial affection in its just appointments. This virtue has something very particular in its nature, and sublime in its efficacy. For it teaches us to bear ill, not only with patience, and as being unavoidable, but it transforms, as it were, ill into good, by leading us to consider it, and every event that has the least appearance of ill, as a divine dispensation, a wise and benevolent temperament of things, subservient to universal good, and of course including that of every individual, especially of such as calmly stoop to it. In this light, the administration itself, nay every act of it, becomes an object of affection, the evil disappears, or is converted into a balm which both heals and nourisheth the mind. For though the first unexpected access of ill may surprise the soul into grief, yet that grief, when the mind calmly reviews its object, changes into contentment, and is by degrees exalted into veneration and a divine composure. Our private will is lost in that of the Almighty, and our security against every real ill rests on the same bottom as the throne of him who lives and reigns for ever.

127 Chief good, *objective* and *formal*.

Before we finish this section, it may be fit to observe, that as the Deity is the supreme and inexhausted source of good, on whom the happiness of the whole creation depends; as he is the highest object in nature, and the only object who is fully proportioned to the intellectual and moral powers of the mind, in whom they ultimately rest, and find their most perfect exercise and completion; he is therefore termed the *Chief good of man*, objectively considered. And *virtue*, or the proportioned and vigorous exercise of the several powers and affections on their respective objects, as above described, is, in the schools, termed the *chief good*, formally considered, or its formal idea, being the inward temper and native constitution of human happiness.

From the detail we have gone through, the following

128 Corollaries.

corollaries may be deduced.

1. It is evident, that the happiness of such a *progressive* creature as man can never be at a stand, or continue a fixed invariable thing. His finite nature, let it rise ever so high, admits still higher degrees of improvement and perfection. And his progression in improvement or virtue always makes way for a progression in happiness. So that no possible point can be assigned in any period of his existence in which he is perfectly happy, that is, so happy as to exclude higher degrees of happiness. All his perfection is only comparative. 2. It appears that many things must conspire to complete the happiness of so *various* a creature as man, subject to so many wants, and susceptible of such different pleasures. 3. As his capacities of pleasure cannot be all gratified at the same time, and must often interfere with each other in such a precarious and fleeting state as human life, or be frequently disappointed, perfect happiness, i. e. the undisturbed enjoyment of the several pleasures of which we are capable, is unattainable in our present state. 4. That state is most to be sought after, in which the fewest competitions and disappointments can happen, which least of all impairs any sense of pleasure, and opens an inexhausted source of the most refined and lasting enjoyments. 5. That state which is attended with all those advantages, is a state or course of virtue. 6. *Therefore*, a state of *virtue*, in which the moral goods of the mind are attained, is the *happiest state*.

Duties of Society.

Chap. III. *Duties of* Society.

Sect. I. *Filial and Fraternal Duty.*

As we have followed the order of nature in tracing the history of man, and those duties which he owes to himself, it seems reasonable to take the same method with those he owes to society, which constitute the *second* class of his *obligations*.

129 Connexion of parents.

His parents are among the earliest objects of his attention; he becomes soonest acquainted with them, reposes a peculiar confidence in them, and seems to regard them with a fond affection, the early prognosties of his future *piety* and *gratitude*. Thus does nature dictate the first lines of filial duty, even before a just sense of the connexion is formed. But when the child is grown up, and has attained to such a degree of understanding, as to comprehend the *moral tie*, and be sensible of the obligations he is under to his parents; when he looks back on their tender and disinterested affection, their incessant cares and labours in nursing, educating, and providing for him, during that state in which he had neither prudence nor strength to care and provide for himself, he must be conscious that he owes to them these peculiar duties.

130 Duties to parents.

1. To reverence and honour them, as the instruments of nature in introducing him to life, and to that state of comfort and happiness which he enjoys; and therefore to esteem and imitate their good qualities, to alleviate and bear with, and spread, as much as possible, a decent veil over their faults and weaknesses.

2. To be highly grateful to them, for those favours which it can hardly ever be in his power fully to repay; to show this gratitude by a strict attention to their wants, and a solicitous care to supply them; by a submissive deference to their authority and advice, especially by paying great regard to it in the choice of a wife, and of an occupation; by yielding to, rather than peevishly contending with, their humours, as remembering how oft they have been persecuted by his; and, in fine, by soothing their cares, lightening their sorrows, supporting the infirmities of age, and making the remainder of their life as comfortable and joyful as possible.

131 Duties to brethren and sisters.

As his brethren and sisters are the next with whom the creature forms a *social* and *moral* connexion, to them he owes a *fraternal* regard; and with them ought he to enter into a strict league of friendship, mutual sympathy, advice, assistance, and a generous intercourse of kind offices, remembering their relation

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to common parents, and that brotherhood of nature which unites them into a closer community of interest and affection.

Sect. II. *Concerning Marriage.*

132 Connexion with the other sex.

When man arrives to a certain age, he becomes sensible of a peculiar sympathy and tenderness towards the other sex; the charms of beauty engage his attention, and call forth new and softer dispositions than he has yet felt. The many amiable qualities exhibited by a fair outside, or by the mild allurement of female manners, or which the prejudiced spectator without much reasoning supposes those to include, with several other circumstances both natural and accidental, point his view and affection to a particular object, and of course contract that general rambling regard, which was lost and useless among the undistinguished crowd, into a peculiar and permanent attachment to one woman, which ordinarily terminates in the most important, venerable, and delightful connexion in life.

133 The grounds of this connexion.

The state of the brute creation is very different from that of human creatures. The former are clothed and generally armed by their structure, easily find what is necessary to their subsistence, and soon attain their vigour and maturity; so that they need the care and aid of their parents but for a short while; and therefore we see that nature has assigned to them vagrant and transient amours. The connexion being purely *natural*, and merely for propagating and rearing their offspring, no sooner is that end answered, than the connexion dissolves of course. But the human race are of a more tender and defenceless constitution; their infancy and non-age continue longer; they advance slowly to strength of body and maturity of reason; they need constant attention, and a long series of cares and labours, to train them up to decency, virtue, and the various arts of life. Nature has, therefore, provided them with the most affectionate and anxious tutors, to aid their weakness, to supply their wants, and to accomplish them in those necessary arts, even their own parents, on whom she has devolved this mighty charge, rendered agreeable by the most alluring and powerful of all ties, parental affection. But unless both concur in this grateful task, and continue their joint labours, till they have reared up and planted out their young colony, it must become a prey to every rude invader, and the purpose of nature in the original union of the human pair be defeated. Therefore our structure as well as condition is an evident indication, that the human sexes are destined for a more intimate, for a moral and lasting union. It appears likewise, that the principal end of marriage is not to propagate and nurse up an offspring, but to educate and form minds for the great duties and extensive destinations of life. Society must be supplied from this original nursery with useful members, and its fairest ornaments and supports.

134 Moral ends of marriage.

The mind is apt to be dissipated in its views and acts of friendship and humanity; unless the *former* be directed to a particular object, and the *latter* employed in a particular province. When men once indulge in this dissipation, there is no stopping their career; they grow insensible to moral attractions; and, by obstructing or impairing the decent and regular exercise of the tender and generous feelings of the human heart, they in time become unqualified for, or averse to, the forming a moral union of souls, which is the cement of society, and the source of the purest domestic joys. Whereas a rational, undepraved *love*, and its fair companion, *marriage*, collect a man's views, guide his heart to its proper object, and, by confining his affection to that object, do really enlarge its influence and use. Besides, it is but too evident from the conduct of mankind, that the common ties of humanity are too feeble to engage and interest the passions of the generality in the affairs of society. The connexions of neighbourhood, acquaintance, and general intercourse, are too wide a field of action for many, and those of a *public* or *community* are so for more; and in which they *either care not or know not how* to exert themselves. Therefore nature, ever wise and benevolent, by implanting that strong sympathy which reigns between the individuals of each sex, and by urging them to form a particular moral connexion, the spring of many domestic endearments, has measured out to each pair a particular *sphere* of *action*, proportioned to their views, and adapted to their respective capacities. Besides, by interesting them deeply in the concerns of their own little circle, she has connected them more closely with society, which is composed of particular families, and bound them down to their good behaviour in that particular community to which they belong. *This moral connexion* is *marriage*, and this *sphere of action* is a *family*.

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135 Duties of marriage.

Of the *conjugal* alliance the following are the *natural laws*. First, Mutual fidelity to the marriage bed. Disloyalty defeats the very end of marriage; dissolves the natural cement of the relation; weakens the moral tie, the chief strength of which lies in the reciprocation of affection; and by making the offspring uncertain, diminishes the care and attachment necessary to their education.

2. A conspiration of counsels and endeavours to promote the common interest of the family, and to educate their common offspring. In order to observe these laws, it is necessary to cultivate, both before and during the married state, the strictest decency and chastity of manners, and a just sense of what becomes their respective characters.

3. The union must be inviolable, and for life. The nature of friendship, and particularly of this species of it, the education of their offspring, and the order of society and of successions, which would otherwise be extremely perplexed, do all seem to require it. To preserve this union, and render the matrimonial state more harmonious and comfortable, a mutual esteem and tenderness, a mutual deference and forbearance, a communication of advice, and assistance and authority, are absolutely necessary. If either party keep within their proper departments, there need be no disputes about power or superiority, and there will be none. They have no *opposite* no *separate* interests, and therefore there can be no just ground for opposition of conduct.

136 Polygamy.

From this detail, and the present state of things, in which there is pretty near a parity of numbers of both sexes, it is evident that *polygamy* is an *unnatural* state; and though it should be granted to be more fruitful

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of children, which however it is not found to be, yet it is by no means so fit for rearing minds, which seems to be as much, if not more, the intention of nature than the propagation of bodies.

Sect. III. *Of Parental Duty.*

137 Connexion of parents and children.

The connexion of parents with their children is a natural consequence of the matrimonial connexion; and the duties which they owe them result as naturally from that connexion. The feeble state of children, subject to so many wants and dangers, requires their incessant care and attention; their ignorant and uncultivated minds demand their continual instruction and culture. Had human creatures come into the world with the full strength of *men*, and the weakness of reason and vehemence of passions which prevail in *children*, they would have been too strong or too stubborn to have submitted to the government and instruction of their parents. But as they were designed for a progression in knowledge and virtue, it was proper that the growth of their bodies should keep pace with that of their minds, lest the purposes of that progression should have been defeated. Among other admirable purposes which this gradual expansion of their outward as well as inward structure serves, this is one, that it affords ample scope to the exercise of many tender and generous affections, which fill up the domestic life with a beautiful variety of duties and enjoyments; and are of course a noble discipline for the heart, and a hardy kind of education for the more honourable and important duties of *public* life.

138 The authority founded on that connexion.

The above-mentioned weak and ignorant state of children seems plainly to invest their parents with such authority and power as is necessary to their support, protection, and education; but that authority and power can be construed to extend no farther than is necessary to answer those ends, and to last no longer than that weakness and ignorance continue; wherefore, the foundation or reason of the authority and power ceasing, they cease of course. Whatever power or authority then it may be necessary or lawful for parents to exercise during the non-age of their children, to assume or usurp the same when they have attained the maturity or full exercise of their strength and reason would be tyrannical and unjust. From hence it is evident, that parents have no right to punish the persons of their children more severely than the nature of their wardship requires, much less to invade their lives, to encroach upon their liberty, or transfer them as their property to any master whatsoever.

139 Duties of parents.

The first class of duties which parents owe their children respect their natural life; and these comprehend protection, nurture, provision, introducing them into the world in a manner suitable to their rank and fortune, and the like.

140 Education.

The second order of duties regards the *intellectual* and *moral* life of their children, or their education in such arts and accomplishments as are necessary to qualify them for performing the duties they owe to themselves and to others. As this was found to be the principal design of the matrimonial alliance, so the fulfilling that design is the most important and dignified of all the parental duties. In order therefore to fit the child for acting his part wisely and worthily as a *man*, as a *citizen*, and a *creature of God*, both parents ought to combine their joint wisdom, authority, and power, and each apart to employ those talents which are the peculiar excellency and ornament of their respective sex. The father ought to *lay out* and *superintend* their education, the mother to execute and manage the detail of which she is capable. The *former* should direct the manly exertion of the intellectual and moral powers of his child. His imagination, and the manner of those exertions, are the peculiar province of the *latter*. The *former* should advise, protect, command, and, by his experience, masculine vigour, and that superior authority which is commonly ascribed to his sex, brace and strengthen his pupil for *active* life, for gravity, integrity, and firmness in suffering. The business of the *latter* is to bend and soften her *male* pupil, by the charms of her conversation, and the softness and decency of her manners, for *social* life, for politeness of taste, and the elegant decorums and enjoyments of humanity; and to improve and refine the tenderness and modesty of her *female* pupil, and form her to all those mild domestic virtues which are the peculiar characteristics and ornaments of her sex: To conduct the opening minds of their sweet charge through the several periods of their progress, to assist them in each period, in throwing out the latent seeds of reason and ingenuity, and in gaining fresh accessions of light and virtue; and at length, with all these advantages, to produce the young adventurers upon the great theatre of human life, to play their several parts in the sight of their friends, of society, and mankind.

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Sect. IV. *Herile and Servile Duty.*

141 The groun of this con nexion.

In the natural course of human affairs, it must necessarily happen that some of mankind will live in plenty and opulence, and others be reduced to a state of indigence and poverty. The former need the labours of the latter, and the latter provision and support of the former. This mutual necessity is the foundation of that connexion, whether we call it *moral* or *civil*, which subsists between masters and servants. He who feeds another has a right to some equivalent, the labour of him whom he maintains, and the fruits of it. And he who labours for another has a right to expect that he should support him. But as the labours of a man of ordinary strength are certainly of greater value than mere food and clothing; because they would actually produce more, even the maintenance of a family, were the labourer to employ them in his own behalf; therefore he has an undoubted right to rate and dispose of his service for certain wages above mere maintenance; and if he has incautiously disposed of it for the latter only, yet the contract being of the *onerous* kind, he may equitably claim a supply of that deficiency. If the service be specified, the servant is bound to that only; if not, then he is to be construed as bound only to such services as are consistent with the laws of justice and humanity. By the voluntary servitude to which he subjects himself, he forfeits no rights but such as are necessarily included in that servitude, and is obnoxious to no punishment but such as a voluntary failure in the service may be supposed reasonably to require. *The offspring of such servants* have a right to that

142 The condi tions of ser vice.

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that liberty which neither they nor their parents have forfeited.

143 The case of great offenders.

As to those who, because of some heinous offence, or for some notorious damage, for which they cannot otherwise compensate, are condemned to perpetual service, they do not, on that account, forfeit all the rights of men; but those, the loss of which is necessary to secure society against the like offences for the future, or to repair the damage they have done.

144 The case of captives.

With regard to captives taken in war, it is barbarous and inhuman to make perpetual slaves of them, unless some peculiar and aggravated circumstances of guilt have attended their hostility. The bulk of the subjects of any government engaged in war may be fairly esteemed innocent enemies; and therefore they have a right to that clemency which is consistent with the common safety of mankind, and the particular security of that society against which they are engaged. Though ordinary captives have a grant of their lives, yet to pay their liberty as an equivalent is much too high a price. There are other ways of acknowledging or returning the favour, than by surrendering what is far dearer than life itself*. To those who, under pretext of the necessities of commerce, drive the unnatural trade of bargaining for human flesh, and consigning their innocent but unfortunate fellow creatures to eternal servitude and misery, we may address the words of a fine writer; "Let avarice defend it as it will, there is an honest reluctance in humanity against buying and selling, and regarding those of our own species as our wealth and possessions."

* *Hutches. Mor. Inst Phil.* lib iii. c. 3.

Sect. V. *Social Duties of the private Kind.*

Hitherto we have considered only the *domestic economical* duties, because these are first in the progress of nature. But as man passes beyond the little circle of a family, he forms connexions with relations, friends, neighbours, and others; from whence results a new train of duties of the more private social kind, as "friendship, chastity, courtesy, good neighbourhood, charity, forgiveness, hospitality."

145 Man's aptitude for society.

Man is admirably formed for particular social attachments and duties. There is a peculiar and strong propensity in his nature to be affected with the sentiments and dispositions of others Men, like certain musical instruments, are set to each other, so that the vibrations or notes excited in one raise correspondent notes and vibrations in the others. The impulses of *pleasure* or *pain*, *joy* or *sorrow*, made on one mind, are by an instantaneous sympathy of nature communicated in some degree to all; especially when hearts are (as a humane writer expresses it) in *unison* of kindness; the joy that vibrates in one communicates to the other also. We may add, that though joy thus imparted swells the harmony, yet grief vibrated to the heart of a friend, and rebounding from thence in sympathetic notes, melts as it were, and almost dies away. All the passions, but especially those of the social kind, are contagious; and when the passions of one man mingle with those of another, they increase and multiply prodigiously. There is a most moving eloquence in the human countenance, air, voice and gesture, wonderfully expressive of the most latent feelings and passions of the soul, which darts them like a subtle flame into the hearts of others, and raises correspondent feelings there: friendship, love, good humour, joy, spread through every feature, and particularly shoot from the eyes their softer and fiercer fires with an irresistible energy. And in like manner the opposite passions of hatred, enmity, ill humour, melancholy, diffuse a sullen and saddening air over the face, and flashing from eye to eye, kindle a train of similar passions. By these, and other admirable pieces of machinery, men are formed for society and the delightful interchange of friendly sentiments and duties, to increase the happiness of others by participation, and their own by rebound; and to diminish, by dividing, the common stock of their misery.

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146 Duties arising from private relation.

The first emanations of the *social* principle beyond the bounds of a family lead us to form a nearer conjunction of friendship or good will with those who are anywise connected with us by *blood* or *domestic alliance*. To them our affection does commonly exert itself in a greater or less degree, according to the nearness or distance of the relation. And this proportion is admirably suited to the extent of our powers and the indigence of our state; for it is only within those lesser circles of consanguinity or alliance that the generality of mankind are able to display their abilities or benevolence, and consequently to uphold their connexion with society, and subserviency to a public interest. Therefore it is our duty to regard these closer connexions as the next department to that of a family, in which nature has marked out for us a sphere of activity and usefulness; and to cultivate the kind affections which are the cement of these endearing alliances.

147 Ingredients of friendship.

Frequently the view of distinguishing moral qualities in some of our acquaintance may give birth to that more noble connexion we call FRIENDSHIP, which is far superior to the alliances of consanguinity. For these are of a superficial, and often of a transitory nature, of which as they hold more of *instinct* than of *reason*, we cannot give such a rational account. But *friendship* derives all its strength and beauty, and the only existence which is durable, from the qualities of the heart, or from virtuous and lovely dispositions. Or, should these be wanting, they or some shadow of them must be supposed present.—Therefore *friendship* may be described to be, "The union of two souls by means of *virtue*, the common object and cement of their mutual affection." Without virtue, or the supposition of it, friendship is only a *mercenary* league, an alliance of interest, which must dissolve of course when that interest decays or subsists no longer. It is not so much any particular passion, as a composition of some of the noblest feelings and passions of the mind. *Good sense*, a *just taste* and *love of virtue*, a *thorough candour and benignity of heart*, or what we usually call a *good temper*, and a generous sympathy of sentiments and affections, are the necessary ingredients of this virtuous connexion. When it is grafted on esteem, strengthened by habit, and mellowed by time, it yields infinite pleasure, ever new and ever growing; is a noble support amidst the various trials and vicissitudes of life, and a high seasoning to most of our other enjoyments.—To form and cultivate virtuous friendship, must be very improving to the temper, as its principal object is *virtue*, set off with all the allurement of countenance, air,

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air, and manners, shining forth in the native graces of manly honest sentiments and affections, and rendered *visible* as it were to the friendly spectator in a conduct unaffectedly great and good; and as its principal exercises are the very energies of virtue, or its effect and emanations. So that wherever this amiable attachment prevails, it will exalt our admiration and attachment to virtue, and unless impeded in its course by unnatural prejudices, run out into a friendship to the human race. For as no one can merit, and none ought to usurp, the sacred name of friend, who hates mankind: so whoever truly loves *them*, possesses the most essential quality of a true friend.

146 Its duties.

The duties of friendship are a mutual esteem of each other, unbribed by interest, and independent of it; a generous confidence, as far distant from suspicion as from reserve; an inviolable harmony of sentiments and dispositions, of designs and interests; a fidelity unshaken by the changes of fortune; a constancy unalterable by distance of time or place; a resignation of one's personal interest to those of one's friend, and a reciprocal, unenvious, unreserved exchange of kind offices.—But, amidst all the exertions of this moral connexion, humane and generous as it is, we must remember that it operates within a narrow sphere, and its immediate operations respect only the individual; and therefore its particular impulses must still be subordinate to a more public interest, or be always directed and controlled by the more extensive connexions of our nature.

149 Love and chastity.

When our friendship terminates on any of the other sex, in whom beauty or agreeableness of person and external gracefulness of manners conspire to express and heighten the moral charm of a tender honest heart, and sweet, ingenuous, modest temper, lighted up by good sense; it generally grows into a more soft and endearing attachment. When this attachment is improved by a growing acquaintance with the worth of its object, is conducted by discretion, and issues at length, as it ought to do, in the moral connexion formerly mentioned *, it becomes the source of many amiable duties, of a communication of passions and interests, of the most refined decencies, and of a thousand nameless deep-felt joys of reciprocal tenderness and love, flowing from every look, word, and action. Here friendship acts with double energy, and the *natural* conspires with the *moral* charms to strengthen and secure the love of virtue. As the delicate nature of female honour and decorum, and the inexpressible grace of a chaste and modest behaviour are the surest and indeed the only means of kindling at first, and ever after of keeping alive, this tender and elegant flame, and of accomplishing the excellent ends designed by it; to attempt by fraud to violate one, or, under pretence of passion, to sully and corrupt the other, and, by so doing, to expose the too often credulous and unguarded object, with a wanton cruelty, to the hatred of her own sex and the scorn of ours, and to the lowest infamy of both, is a conduct not only base and criminal, but inconsistent with that truly rational and refined enjoyment, the spirit and quintessence of which are derived from the bashful and sacred charms of virtue kept untainted, and therefore ever alluring to the lover's heart.

* See Sect. ii. of this chapter.

Courtesy, good neighbourhood, affability, and the like duties, which are founded on our private social connexions, are no less necessary and obligatory to creatures united to society, and supporting and supported by each other in a chain of mutual want and dependence. They do not consist in a smooth address, an artificial or obsequious air, fawning adulations or a polite servility of manners; but in a just and modest sense of our own dignity and that of others, and of the reverence due to mankind, especially to those who hold the higher links of the social chain; in a discreet and manly accommodation of ourselves to the foibles and humours of others; in a strict observance of the rules of decorum and civility; but, above all, in a frank obliging carriage, and generous interchange of good deeds rather than words. Such a conduct is of great use and advantage, as it is an excellent security against injury, and the best claim and recommendation to the esteem, civility, and universal respect of mankind. This inferior order of virtues unites the particular members of society more closely, and forms the lesser pillars of the civil fabric; which, in many instances, supply the unavoidable defects of laws, and maintain the harmony and decorum of social intercourse, where the more important and essential lines of virtue are wanting.

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150 Courtesy, good neighbourhood, &c.

151 Charity, forgiveness

Charity and *forgiveness* are truly amiable and useful duties of the social kind. There is a twofold distinction of rights commonly taken notice of by moral writers, viz. *perfect* and *imperfect*. To fulfil the former, is necessary to the being and support of society; to fulfil the latter, is a duty equally sacred and obligatory, and tends to the improvement and prosperity of society; but as the violation of them is not equally prejudicial to the public good, the fulfilling them is not subjected to the cognizance of law, but left to the candour, humanity, and gratitude of individuals. And by this means ample scope is given to exercise all the generosity, and display the genuine merit and lustre of virtue. Thus the wants and misfortunes of others call for our charitable assistance and seasonable supplies. And the good man, unconstrained by law, and uncontrolled by human authority, will cheerfully acknowledge and generously satisfy this mournful and moving claim; a claim supported by the sanction of heaven, of whose bounties he is honoured to be the grateful trustee. If his own *perfect* rights are invaded by the injustice of others, he will not therefore reject their *imperfect* right to pity and forgiveness, unless his grant of these should be inconsistent with the more extensive rights of society, or the public good. In that case he will have recourse to public justice and the laws, and even then he will prosecute the injury with no unnecessary severity, but rather with mildness and humanity. When the injury is merely personal, and of such a nature as to admit of alleviations, and the forgiveness of which would be attended with no worse consequences, especially of a public kind, the good man will generously forgive his offending brother. And it is his duty to do so, and not to take private revenge, or retaliate evil for evil. For though resentment of injury is a natural passion, and implanted, as was observed † above, for wise and good ends; yet, considering the manifold partialities which most men have for themselves, was every one to act as judge in

† See Part ii. chap. iii. and iv.

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in his own cause, and to execute the sentence dictated by his own resentment, it is but too evident that mankind would pass all bounds in their fury, and the last sufferer be provoked in his turn to make full reprisals. So that evil, thus encountering with evil, would produce one continued series of violence and misery, and render society intolerable, if not impracticable. Therefore, where the security of the individual, or the good of the public, does not require a proportionable retaliation, it is agreeable to the general law of benevolence, and to the particular end of the passion (which is to prevent injury and the misery occasioned by it), to forgive personal injuries, or not to return evil for evil. This duty is one of the noble refinements which *Christianity* has made upon the general maxims and practice of mankind, and enforced, with a peculiar strength and beauty, by sanctions no less alluring than awful. And indeed the practice of it is generally its own reward; by expelling from the mind the most dreadful intruders upon its repose, those rancorous passions which are begot and nursed by resentment, and by disarming and even subduing every enemy one has, except such as have nothing left of men but the outward form.

152 Hospitality.

The most enlarged and humane connexion of the private kind seems to be the hospitable alliance, from which flow the amiable and disinterested duties we owe to strangers. If the exercise of passions of the most private and instinctive kind is beheld with moral approbation and delight, how lovely and venerable must those appear which result from a calm philanthropy, are founded in the common rights and connexions of society, and embrace men, not of a particular sect, party, or nation, but all in general without distinction, and without any of the little partialities of self-love.

Sect. VI. *Social Duties of the* Commercial *Kind.*

153 Commercial duties.

The next order of connexions are those which arise from the wants and weakness of mankind, and from the various circumstances in which their different situations place them. These we may call *commercial* connexions, and the duties which result from them *commercial* duties, as *justice, fair-dealing, sincerity, fidelity to compacts*, and the like.

154 Their foundation.

Though nature is perfect in all her works, yet she has observed a manifest and eminent distinction among them. To all such as lie beyond the reach of human skill and power, and are properly of her own department, she has given the finishing hand. These man may design after and imitate, but he can never rival them, nor add to their beauty or perfection. Such are the forms and structure of vegetables, animals, and many of their productions, as the honey comb, the spider's web, and the like. There are others of her works which she has of design left unfinished, as it were, in order to exercise the ingenuity and power of man. She has presented to him a rich profusion of materials of every kind for his conveniency and use; but they are rude and unpolished, or not to be come at without art and labour. These therefore he must apply, in order to adapt them to his use, and to enjoy them in perfection. Thus nature hath given him an infinite variety of herbs, grains, fossils, minerals, woods, water, earth, air, and a thousand other crude materials, to supply his numerous wants. But he must sow, plant, dig, refine, polish, build, and, in short, manufacture the various produce of nature, in order to obtain even the necessaries, and much more the conveniencies and elegancies of life. These then are the price of his labour and industry, and, without that, nature will sell him nothing. But as the wants of mankind are many, and the single strength of individuals small, they could hardly find the necessaries, and much less the conveniencies of life, without uniting their ingenuity and strength in acquiring these, and without a mutual intercourse of good offices. Some men are better formed for some kinds of ingenuity and labour, and others for other kinds; and different soils and climates are enriched with different productions; so that men, by exchanging the produce of their respective labours, and supplying the wants of one country with the superfluities of another, do in effect diminish the labours of each, and increase the abundance of all. This is the foundation of all commerce, or exchange of commodities and goods, one with another; in order to facilitate which, men have contrived different species of coin, or money, as a common standard by which to estimate the comparative values of their respective goods. But to render commerce sure and effectual, *justice, fair-dealing, sincerity*, and *fidelity to compacts*, are absolutely necessary.

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155 Justice:

Justice or *fair-dealing*, or, in other words, a disposition to treat others as we would be treated by them, is a virtue of the first importance, and inseparable from the virtuous character. It is the cement of society, or that pervading spirit which connects its members, inspires its various relations, and maintains the order and subordination of each part of the whole. Without it, society would become a den of thieves and banditti, hating and hated, devouring and devoured, by one another.

And here it may be proper to take a view of Mr Hume's supposed case of the sensible knave and the worthless miser (N° 16), and consider what would be the duty of the former according to the theory of those moralists who hold the *will of God* to be the *criterion* or *rule*, and *everlasting happiness* the *motive* of human virtue.

156 It universally a duty on the principles of those who hold the will of God to be the criterion of virtue.

It has been already observed, and the truth of the observation cannot be controverted, that, by secretly purloining from the coffers of a miser, part of that gold which there lies useless, a man might in particular circumstances promote the good of society, without doing any injury to a single individual: and it was hence inferred, that, in such circumstances, in would be no duty to abstain from theft, were *local utility* arising from *particular consequences* the real criterion or standard of justice. Very different, however, is the conclusion which must be drawn by those who consider the natural tendency of actions, if universally performed, as the criterion of their merit or demerit, in the sight of God. Such philosophers attend, not to the particular consequences of a single action in any given case, but to the general consequences of the principle from which it flows, if that principle were universally adopted. You cannot (say they) permit one action and forbid another, without showing a difference

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ference between them. The same sort of actions, therefore, must be generally permitted or generally forbidden. But were every man allowed to ascertain for himself the circumstances in which the good of society would be promoted, by secretly abstracting the superfluous wealth of a worthless miser, it is plain that no property could be secure; that all incitements to industry would be at once removed; and that, whatever might be the *immediate* consequences of any *particular theft*, the *general* and *necessary* consequences of the *principle* by which it was authorized must soon prove fatal. Were one man to purloin part of the riches of a real miser, and to consider his conduct as vindicated by his intention to employ those riches in acts of generosity, another might by the same sort of casuistry think himself authorized to appropriate to himself part of his wealth; and thus theft would spread through all orders of men, till society were dissolved into separate, hostile, and savage families, mutually dreading and shunning each other. The general consequences, therefore, of encroaching upon private property tend evidently and violently to universal misery.

On the other hand, indeed, the particular and immediate consequences of that principle which considers every man's property as sacred, may in some cases, such as that supposed, be in a small degree injurious to a few families in the neighbourhood of the miser and the knave. But that injury can never be of long duration; and it is infinitely more than counterbalanced by the general good consequences of the principle from which it accidentally results; for these consequences extend to all nations and to all ages. Without a sacred regard to property, there could neither be arts nor industry nor confidence among men, and happiness would be for ever banished from this world. But the communication of happiness being the end which God had in view when he created the world, and all men standing in the same relation to him, it is impossible to suppose that he does not approve, and will not ultimately reward, those voluntary actions of which the natural tendency is to increase the sum of human happiness; or that he does not disapprove, and will not ultimately punish, those which naturally tend to aggravate human misery. The conclusion is, that a strict adherence to the principle of justice is universally, and in all possible circumstances, a duty from which we cannot deviate without offending our Creator, and ultimately bringing misery upon ourselves.

157 Sincerity.

Sincerity, or *veracity*, in our words and actions, is another virtue or duty of great importance to society, being one of the great bands of mutual intercourse, and the foundation of mutual trust. Without it, society would be the dominion of mistrust, jealousy, and fraud, and conversation a traffic of lies and dissimulation. It includes in it a conformity of our words with our sentiments, a correspondence between our actions and dispositions, a strict regard to truth, and an irreconcilable abhorrence of falsehood. It does not indeed require, that we expose our sentiments indiscreetly, or tell all the truth in every case; but certainly it does not and cannot admit the least violation of truth or contradiction to our sentiments. For if these bounds are once passed, no possible limit can be assigned where the violation shall stop, and no pretence of private or public good can possibly counterbalance the ill consequences of such a violation.

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158 Fidelity to promises, compacts, &c.

Fidelity to promises, *compacts*, and *engagements*, is likewise a duty of such importance to the security of commerce and interchange of benevolence among mankind, that society would soon grow intolerable without the strict observance of it. Hobbes, and others who follow the same track, have taken a wonderful deal of pains to puzzle this subject, and to make all the virtues of this sort merely *artificial*, and not at all *obligatory*, antecedent to human conventions. No doubt compacts suppose people who make them; and promises persons to whom they are made; and therefore both suppose some society, more or less, between those who enter into those mutual engagements. But is not a compact or promise binding, till men have agreed that they shall be binding? or are they only binding, because it is our interest to be bound by them, or to fulfil them? Do not we highly approve the man who fulfils them, even though they should prove to be against his interest? and do not we condemn him as a knave who violates them on that account? A promise is a voluntary declaration by words, or by an action equally significant, of our resolution to do something in behalf of another, or for his service. When it is made, the person who makes it is by all supposed under an obligation to perform it. And he to whom it is made may demand the performance as his right. That perception of *obligation* is a simple idea, and is on the same footing as our other moral perceptions, which may be described by instances, but cannot be defined. Whether we have a perception of such obligation quite distinct from the interest, either public or private, that may accompany the fulfilment of it, must be referred to the conscience of every individual. And whether the mere sense of that obligation, apart from its concomitants, is not a sufficient inducement or motive to keep one's promise, without having recourse to any selfish principle of our nature, must be likewise appealed to the conscience of every honest man.

159 Shown to be duties independent of the authority of the moral sense.

It may, however, be not improper to remark, that in this, as in all other instances, our chief good is combined with our duty. "Men act from expectation. Expectation is in most cases determined by the assurances and engagements which we receive from others. If no dependence could be placed upon these assurances, it would be impossible to know what judgement to form of many future events, or how to regulate our conduct with respect to them. Confidence, therefore, in promises, is essential to the intercourse of human life, because without it, the greatest part of our conduct would proceed upon chance. But there could be no confidence in promises, if men were not obliged to perform them. Those, therefore, who allow not to the perceptions of the moral sense all that authority which we attribute to them, must still admit the obligation to perform promises; because such performance may be shown to be agreeable to the will of God, in the very same manner in which, upon their principles, we have shown the uniform practice of justice to be so.

160 What those duties require.

Fair dealing and *fidelity* to *compacts* require that we take no advantage of the ignorance, passion, or incapacity of others, from whatever cause that incapacity arises;

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arises;—that we be explicit and candid in making bargains, just and faithful in fulfilling our part of them. And if the other party violates his engagements, redress is to be sought from the laws, or from those who are intrusted with the execution of them. In fine, the *commercial* virtues and duties require that we not only do not invade, but maintain the rights of others;—that we be fair and impartial in transferring, bartering, or exchanging property, whether in goods or service; and be inviolably faithful to our word and our engagements, where the matter of them is not criminal, and where they are not extorted by force. See PROMISE.

SECT. VII. *Social Duties of the* POLITICAL *Kind.*

We are now arrived at the last and highest order of duties respecting society, which result from the exercise of the most generous and heroic affections, and are founded on our most enlarged connexions.

161 Political connections.

The social principle in man is of such an expansive nature, that it cannot be confined within the circuit of a family, of friends, or a neighbourhood; it spreads into wider systems, and draws men into larger confederacies, communities, and commonwealths. It is in those only that the higher powers of our nature attain the highest improvement and perfection of which they are capable. These principles hardly find objects in the solitary state of nature. *There* the principle of action rises no higher at farthest than *natural affection* towards one's offspring. There personal or family wants entirely engross the creature's attention and labour, and allow no leisure, or if they did, no exercise for views and affections of a more enlarged kind. In *solitude* all are employed in the same way, in providing for the *animal* life. And even after their utmost labour and care, single and unaided by the industry of others, they find but a sorry supply of their wants, and a feeble precarious security against dangers from wild beasts; from inclement skies and seasons; from the mistakes or petulant passions of their fellow creatures; from their preference of themselves to their neighbours; and from all the little exorbitancies of self-love. But in *society*, the mutual aids which men give and receive shorten the labours of each, and the combined strength and reason of individuals give security and protection to the whole body. There is both a variety and subordination of genius among mankind. Some are formed to lead and direct others, to contrive plans of happiness for individuals and of government for communities, to take in a public interest, invent laws and arts, and superintend their execution, and, in short, to refine and civilize human life. Others, who have no such good heads, may have as honest hearts, a truly public spirit, love of liberty, hatred of corruption and tyranny, a generous submission to laws, order, and public institutions, and an extensive philanthropy. And others, who have none of those capacities either of heart or head, may be well formed for manual exercise and bodily labour. The former of these principles have no scope in solitude, where a man's thoughts and concerns do all either centre in himself or extend no farther than a family; into which little circle all the duty and virtue of the solitary mortal is crowded. But society finds proper objects and exercises for every genius, and the noblest objects and exercises for the noblest geniuses, and for the highest principles in the human constitution; particularly for that warmest and most divine passion which God hath kindled in our bosoms, the inclination of doing good, and reverencing our nature; which may find here both employment and the most exquisite satisfaction. In society, a man has not only more leisure, but better opportunities, of applying his talents with much greater perfection and success, especially as he is furnished with the joint advice and assistance of his fellow creatures, who are now more closely united one with the other, and sustain a common relation to the same moral system or community. This then is an object proportioned to his most enlarged social affections; and in serving it he finds scope for the exercise and refinement of his highest intellectual and moral powers. *Therefore society*, or *a state of civil government*, rests on these two principal pillars, "That in it we find security against those evils which are unavoidable in solitude,—and obtain those goods, some of which cannot be obtained at all, and others not so well, in that state where men depend solely on their individual sagacity and industry."

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From this short detail it appears, that *man* is a *social* creature, and formed for a *social* state; and that *society*, being adapted to the higher principles and destinations of his nature, must of necessity be his *natural* state.

162 Political duties.

The duties suited to that state, and resulting from those principles and destinations, or, in other words, from our social passions and social connexions, or relation to a public system, are, *love of our country, resignation and obedience to the laws, public spirit, love of liberty, sacrifice of life and all to the public, and the like.*

163 Love of one's country.

Love of our country, is one of the noblest passions that can warm and animate the human breast. It includes all the limited and particular affections to our parents, friends, neighbours, fellow citizens, countrymen. It ought to direct and limit our more confined and partial actions within their proper and natural bounds, and never let them encroach on those sacred and first regards we owe to the great public to which we belong. Were we solitary creatures, detached from the rest of mankind, and without any capacity of comprehending a *public interest*, or without affections leading us to desire and pursue it, it would not be our duty to mind it, nor criminal to neglect it. But as we are PARTS of the *public system*, and are not only capable of taking in large views of its interests, but by the strongest affections connected with it, and prompted to take a share of its concerns, we are under the most sacred ties to prosecute its security and welfare with the utmost ardour, especially in times of public trial. This *love of our country* does not import an attachment to any particular soil, climate, or spot of earth, where perhaps we first drew our breath, though those *natural* ideas are often associated with the *moral* ones, and, like external signs or symbols, help to ascertain and bind them; but it imports an affection to that *moral system*, or *community*, which is governed by the same laws and magistrates, and whose several parts are variously connected one with the other, and

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all united upon the bottom of a common interest. Perhaps indeed every member of the community cannot comprehend so large an object, especially if it extends through large provinces, and over vast tracts of land: and still less can he form such an idea, if there is no *public*, i. e. if all are subject to the caprice and unlimited will of one man; but the preference the generality show to their native country, the concern and longing after it which they express when they have been long absent from it; the labours they undertake and sufferings they endure to save or serve it, and the peculiar attachment they have to their countrymen, evidently demonstrate that the passion is *natural*, and never fails to exert itself when it is fairly disengaged from foreign clogs, and is directed to its proper object. Wherever it prevails in its genuine vigour and extent, it swallows up all sordid and selfish regards; it conquers the love of *ease*, *power*, *pleasure*, and *wealth*; nay, when the amiable partialities of *friendship*, *gratitude*, *private affection*, or *regards to a family*, come in competition with it, it will teach us bravely to sacrifice all, in order to maintain the rights, and *promote* or *defend* the honour and happiness, of our country.

164 Resignation and obedience to the laws, &c.

Resignation and *obedience to the laws* and *orders* of the society to which we belong, are *political* duties necessary to its very being and security, without which it must soon degenerate into a state of licentiousness and anarchy. The welfare, nay, the nature of civil society, requires, that there should be a subordination of orders, or diversity of ranks and conditions in it;—that certain men, or orders of men, be appointed to superintend and manage such affairs as concern the public safety and happiness;—that all have their particular provinces assigned them; that such a subordination be settled among them as none of them may interfere with another; and finally, that certain *rules* or *common measures of action* be agreed on, by which each is to discharge his respective duty to govern or be governed, and all may concur in securing the order, and promoting the felicity, of the whole political body. Those *rules of action* are the *laws* of the community; and those different *orders* are the several officers or magistrates appointed by the public to explain them, and superintend or assist in their execution. In consequence of this settlement of things, it is the duty of each individual to obey the laws enacted; to submit to the executors of them with all due deference and homage, according to their respective ranks and dignity, as to the keepers of the public peace, and the guardians of public liberty; to maintain his own rank, and perform the functions of his own station, with diligence, fidelity, and incorruption. The superiority of the *higher* orders, or the authority with which the state has invested them, entitle them, especially if they employ their authority well, to the obedience and submission of the *lower*, and to a proportionable honour and respect from all. The subordination of the lower ranks claims protection, defence, and security from the higher. And the laws, being superior to all, require the obedience and submission of all, being the last resort, beyond which there is no decision or appeal.

Public spirit, *heroic zeal*, *love of liberty*, and the other *political* duties, do, above all others, recommend those who practise them to the admiration and homage of mankind; because, as they are the offspring of the noblest minds, so *are they* the parents of the greatest blessing to society. Yet, exalted as they are, it is only in equal and free governments where they can be exercised and have their due effect; for there only does a true *public spirit* prevail, and there only is the *public good* made the standard of the civil constitution. As the end of society is the *common interest* and *welfare* of the people associated, this end must of necessity be the *supreme law*, or *common standard*, by which the particular rules of action of the several members of the society towards each other are to be regulated. But a *common interest* can be no other than that which is the result of the *common reason* or *common feelings* of all. Private men, or a particular order of men, have interests and feelings peculiar to themselves, and of which they may be good judges; but these may be separate from, and often contrary to, the interests and feelings of the rest of the society; and therefore they can have no right to make, and much less to impose, laws on their fellow citizens, inconsistent with, and opposite to, those interests and those feelings. Therefore, a *society*, *a government*, or *real public*, truly worthy the name, and not a confederacy of banditti, a clan of lawless savages, or a band of slaves under the whip of a master, must be such a one as consists of freemen, choosing or consenting to laws themselves; or, since it often happens that they cannot assemble and act in a *collective body*, delegating a sufficient number of *representatives*, i. e. such a number as shall most fully comprehend, and most equally represent, their *common feelings* and *common interests*, to digest and vote laws for the conduct and controul of the whole body, the most agreeable to those common feelings and common interests.

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165 Foundation of public spirit, love of liberty, &c.

166 Political duties of every citizen.

A society thus constituted by *common reason*, and formed on the plan of a *common interest*, becomes immediately an object of public attention, public veneration, public obedience, a public and inviolable attachment, which ought neither to be seduced by bribes, nor awed by terrors; an object, in fine, of all those extensive and important duties which arise from so glorious a confederacy. To watch over such a system; to contribute all he can to promote its good by his reason, his ingenuity, his strength, and every other ability, whether natural or acquired; to resist, and, to the utmost of his power, defeat every encroachment upon it, whether carried on by a secret corruption or open violence; and to sacrifice his ease, his wealth, his power, nay life itself, and, what is dearer, still, his family and friends, to defend or save it, is the duty, the honour, the interest, and the happiness of every citizen; it will make him venerable and beloved while he lives, be lamented and honoured if he falls in so glorious a cause, and transmit his name with immortal renown to the latest posterity.

167 Of the people.

As the PEOPLE are the fountain of power and authority, the original seat of majesty, the authors of laws, and the creators of officers to execute them; if they shall find the power they have conferred abused by their trustees, their majesty violated by tyranny or by usurpation, their authority prostituted to support violence or screen corruption, the laws grown pernicious through accidents unforeseen or unavoidable, or rendered

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rendered ineffectual through the infidelity and corruption of the executors of them; then it is their right, and what is their right is their duty, to resume that delegated power, and call their trustees to an account; to resist the usurpation, and extirpate the tyranny; to restore their sullied majesty and prostituted authority; to suspend, alter, or abrogate those laws, and punish their unfaithful and corrupt officers. Nor is it the duty only of the united body; but every member of it ought, according to his respective rank, power, and weight in the community, to concur in advancing and supporting these glorious designs.

Resistance, therefore, being undoubtedly lawful in extraordinary emergencies, the question, among good reasoners, can only be with regard to the degree of necessity which can justify resistance, and render it expedient or commendable. And here we must acknowledge, that, with Mr Hume *, "we shall always incline to their side that draw the bond of allegiance very close, and who consider an infringement of it as the last refuge in desperate cases, when the public is in the highest danger from violence and tyranny. For besides the mischiefs of a civil war, which commonly attends insurrection, it is certain, that where a disposition to rebellion appears among any people, it is one chief cause of tyranny in the rulers, and forces them into many violent measures, which, had every one been inclined to submission and obedience, they would never have embraced. Thus the *tyrannicide*, or assassination approved of by ancient maxims, instead of keeping tyrants and usurpers in awe, made them ten times more fierce and unrelenting; and is now justly abolished on that account by the laws of nations, and universally condemned, as a base and treacherous method of bringing to justice those disturbers of society."

* *Essays*, vol. i.

Chap. IV. *Duty to* God.

168 Divine connexions.

Of all the *relations* which the human mind sustains, that which subsists between the *Creator* and his *creatures*, the supreme *Lawgiver* and his *subjects*, is the highest and the best. This relation arises from the *nature* of a *creature* in general, and the *constitution* of the *human mind* in particular; the noblest powers and affections of which point to an *universal* Mind, and would be imperfect and abortive without such a direction. How lame then must that system of morals be, which leaves a *Deity* out of the question! How disconsolate, and how destitute of its firmest support!

169 Existence of God.

It does not appear, from any true history or experience of the mind's progress, that any man, by any formal deduction of his discursive power, ever reasoned himself into the belief of a God. Whether such a belief is only some *natural anticipation* of soul, or is derived from father to son, and from one man to another, in the way of *tradition*, or is suggested to us in consequence of an *immutable law of our nature*, on beholding the august aspect and beautiful order of the universe, we will not pretend to determine. What seems most agreeable to experience is, that a *sense* of its *beauty* and *grandeur*, and the *admirable fitness* of one thing to another in its vast apparatus, leads the mind *necessarily* and *unavoidably* to a perception of a *design*, or of a *designing cause*, the origin of all, by a progress as simple and natural as that by which a *beautiful picture* or a *fine building* suggests to us the idea of an *excellent artist*. For it seems to hold universally true, that wherever we discern a *tendency* or *co-operation of things towards a certain end*, or producing a common effect, there, by a necessary *law of association*, we apprehend *design*, a *designing energy* or *cause*. No matter whether the objects are *natural* or *artificial*, still that suggestion is unavoidable, and the *connexion* between the *effect* and its *adequate cause* obtrudes itself on the mind, and it requires no nice search or elaborate deduction of reason to trace or prove that connexion. We are particularly satisfied of its truth in the subject before us by a kind of direct intuition; and we do not seem to attend to the maxim we learn in schools, "That there cannot be an *infinite series* of *causes* and *effects*, producing and produced by one another." That maxim is familiar only to metaphysicians; but all men of sound understanding are led to believe the existence of a God. We are conscious of our *existence*, of *thought*, *sentiment*, and *passion*, and sensible withal that these came not of ourselves; therefore we immediately recognize a *parent mind*, an *original intelligence*, from whom we borrowed those little portions of thought and activity. And while we not only feel *kind* affections in ourselves, and discover them in others, but likewise behold round us such a number and variety of creatures, endued with natures nicely adjusted to their several stations and economies, supporting and supported by each other, and all sustained by a *common order* of things, and sharing different degrees of happiness according to their respective capacities, we are naturally and necessarily led up to the Father of such a numerous offspring, the fountain of such wide-spread happiness. As we conceive this Being before all, above all, and greater than all, we naturally, and without reasoning, ascribe to him every kind of perfection, wisdom, power, and goodness without bounds, existing through all time, and pervading all space. We apply to him those glorious epithets of our *Creator*, *Preserver*, *Benefactor*, the *supreme Lord* and *Lawgiver* of the whole society of rational and intelligent creatures. Not only the imperfections and wants of our being and condition, but some of the noblest instincts and affections of our minds, connect us with this great and universal nature. The mind, in its progress from object to object, from one character and prospect of beauty to another, finds some blemish or deficiency in each, and soon exhausts or grows weary and dissatisfied with its subject; it sees no character of excellency among men equal to that pitch of esteem which it is capable of exerting; no object within the compass of human things adequate to the strength of its affection: nor can it stay anywhere in this self-expansive progress, or find repose after its highest flights, till it arrives at a Being of unbounded greatness and worth, on whom it may employ its sublimest powers without exhausting the subject, and give scope to the utmost force and fulness of its love without satiety or disgust. So that the nature of this Being corresponds to the nature of man; nor can his intelligent and moral powers obtain their entire end, but on the supposition of such a Being, and without a real sympathy and communication with him. The native propensity of the mind to reverence whatever is *great* and *wonderful* in nature, finds a proper object of homage in him who spread out the heavens

Duty to God.

170 His relation to the human mind.

and

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and the earth, and who sustains and governs the whole of things. The *admiration* of beauty, the *love* of order, and the *complacency* we feel in goodness, must rise to the highest pitch, and attain the full vigour and joy of their operations, when they unite in him who is the sum and source of all perfection.

171 Immorality of impiety.

It is evident from the slightest survey of morals, that how punctual soever one may be in performing the duties which result from our relations to mankind, yet to be quite deficient in performing those which arise from our *relation* to the *Almighty*, must argue a strange perversion of *reason* or depravity of *heart*. If imperfect degrees of worth attract our veneration, and if the want of it would imply an insensibility, or, which is worse, an aversion to merit, what lameness of affection or immorality of character must it be to be unaffected with, and much more to be ill-affected to, a Being of superlative worth! To love society, or particular members of it, and yet to have no sense of our connexion with its Head, no affection to our common Parent and Benefactor; to be concerned about the approbation or censure of our fellow creatures, and yet to feel nothing of this kind towards him who sees and weighs our actions with unerring wisdom and justice, and can fully reward or punish them, betrays equal madness and partiality of mind. It is plain, therefore, beyond all doubt, that some regards are due to the great Father of all, in whom every lovely and adorable quality combines to inspire veneration and homage.

172 Right opinions of God.

As it has been observed already, that our *affections* depend on our *opinions* of their objects, and generally keep pace with them, it must be of the highest importance, and seems to be among the first duties we owe to the Author of our being, "to form the least imperfect, since we cannot form perfect, conceptions of his *character* and *administration*." For such *conceptions*, thoroughly imbibed, will render our *religion* rational, and our *dispositions* refined. If our *opinions* are diminutive and distorted, our religion will be superstitious, and our temper abject. Thus, if we ascribe to the Deity that false majesty which consists in the unbenevolent and sullen exercise of mere *will* or *power*, or suppose him to delight in the prostrations of servile fear, or as servile praise, he will be worshipped with mean adulation and a profusion of compliments. Farther, If he be looked upon as a stern and implacable Being, delighting in vengeance, he will be adored with pompous offerings, sacrifices, or whatever else may be thought proper to soothe and mollify him. But if we believe *perfect goodness* to be the character of the supreme Being, and that he loves those most who resemble him most, the worship paid him will be rational and sublime, and his worshippers will seek to please him by imitating that goodness which they adore.

173 Rational faith.

The foundation then of all true religion is a *rational faith*. And of a rational faith these seem to be the chief articles, to believe, "that an infinite all-perfect Mind exists, who has no opposite nor any separate interest from that of his creatures: that he superintends and governs all creatures, and things;—that his goodness extends to all his creatures, in different degrees indeed, according to their respective natures, but without any partiality or envy:—that he does every thing for the best, or in a subservieney to the perfection and happiness of the whole; particularly that he directs and governs the affairs of men, inspects their actions, distinguishes the *good* from the *bad*, loves and befriends the former, is displeased with and pities the latter in *this* world, and will according to their respective deserts reward one and punish the other in the next;—that, in fine, he is always carrying on a scheme of virtue and happiness through an unlimited duration; and is ever guiding the universe, through its successive stages and periods, to higher degrees of perfection and felicity." This is true *Theism*, the glorious scheme of divine faith; a scheme exhibited in all the works of God, and executed through his whole administration.

Duty to God.

174 Morality theism.

This faith, well founded and deeply felt, is nearly connected with a *true moral taste*, and hath a powerful efficacy on the temper and manners of the theist. He who admires goodness in others, and delights in the practice of it, must be conscious of a reigning order within, a rectitude and candour of heart, which disposes him to entertain favourable apprehensions of men, and, from an impartial survey of things, to presume that *good order* and *good meaning* prevail in the universe; and if good meaning and good order, then an *ordering*, an *intending mind*, who is no enemy, no tyrant to his creatures, but a *friend*, a *benefactor*, an *indulgent sovereign*. On the other hand, a bad man, having nothing goodly or generous *to contemplate within*, no right intentions, nor honesty of heart, suspects every person and every thing; and, beholding nature through the gloom of a selfish and guilty mind, is either averse to the belief of a reigning order, or, if he cannot suppress the unconquerable anticipations of a governing mind, he is prone to tarnish the beauty of nature, and to impute malevolence, or blindness and impotence at least, to the Sovereign Ruler. He turns the universe into a forlorn and horrid waste, and transfers his own character to the Deity, by ascribing to him that uncommunicative grandeur, that arbitrary or revengeful spirit, which he affects or admires in himself. As such a temper of mind naturally leads to *atheism*, or to a *superstition* fully as bad; therefore, as far as that temper depends on the unhappy creature on whom it prevails, the propensity to atheism or superstition consequent thereto must be *immoral*. Farther, If it be true that the belief or sense of a Deity is natural to the mind, and the evidence of his existence reflected from his works so full as to strike even the most superficial observer with conviction, then the supplanting or corrupting that sense, or the want of due attention to that evidence, and, in consequence of both, a supine ignorance or affected unbelief of a Deity, must argue a bad temper or an immoral turn of mind. In the case of invincible ignorance, or a very bad education, though nothing can be concluded directly against the character; yet whenever ill passions and habits pervert the judgment, and by perverting the judgment terminate in atheism, then the case becomes plainly criminal.

175 Immorality of atheism

But let casuists determine this as they will, a true faith in the divine character and administration is generally the consequence of a virtuous state of mind. The man who is truly and habitually good, feels the *love of order*, of *beauty*, and *goodness*, in the strongest degree; and therefore cannot be insensible to those emanations of them which appear in all the works of God,

176 The connexion of theism and virtue.

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nor help loving their supreme source and model. He cannot but think, that he who has poured such beauty and goodness over all his works, must himself delight in beauty and goodness, and what he delights in must be both amiable and happy. Some indeed there are, and it is pity there should be any such, who, through the unhappy influence of a wrong education, have entertained dark and unfriendly thoughts of the Deity and his administration, though otherwise of a virtuous temper themselves. However, it must be acknowledged, that such sentiments have, for the most part, a bad effect on the temper; and when they have not, it is because the undepraved affections of an honest *heart* are more powerful in their operation than the speculative opinions of an ill-informed *head*.

177 Duties of gratitude, love, &c.

But wherever right conceptions of the Deity and his providence prevail, when he is considered as the inexhausted source of light, and love, and joy, as acting in the joint character of a *Father* and *Governor*, imparting an endless variety of capacities to his creatures, and supplying them with every thing necessary to their full completion and happiness; what veneration and gratitude must such conceptions, thoroughly believed, excite in the mind? How natural and delightful must it be to one whose heart is open to the perception of truth, and of every thing *fair*, *great*, and *wonderful* in nature, to contemplate and adore him who is the first *fair*, the first *great*, and first *wonderful*; in whom *wisdom*, *power*, and *goodness*, dwell vitally, essentially, originally, and act in perfect concert? What *grandeur* is here to fill the most enlarged capacity, what *beauty* to engage the most ardent love, what a mass of *wonders* in such exuberance of perfection to astonish and delight the human mind through an unfailing duration!

178 Other affections.

If the *Deity* is considered as our supreme *Guardian* and *Benefactor*, as the *Father of Mercies*, who loves his creatures with infinite tenderness, and in a particular manner all good men, nay all who delight in goodness, even in its most imperfect degrees; what resignation, what dependence, what generous confidence, what hope in God and his all-wise providence, must arise in the soul that is possessed of such amiable views of him! All those exercises of piety, and above all a superlative esteem and love, are directed to God as to their *natural*, their *ultimate*, and indeed their only *adequate* object; and though the immense obligations we have received from him may excite in us more lively feelings of divine goodness than a general and abstracted contemplation of it, yet the affections of *gratitude* and *love* are of themselves of the generous disinterested kind, not the result of self-interest, or views of reward. A perfect character, in which we always suppose infinite goodness, guided by unerring wisdom, and supported by almighty power, is the proper object of perfect love; which, as such, we are forcibly drawn to pursue and to aspire after. In the contemplation of the divine nature and attributes, we find at last what the ancient philosophers sought in vain, the SUPREME AND SOVEREIGN GOOD; from which all other goods arise, and in which they are all contained. The Deity therefore challenges our supreme and sovereign love, a sentiment which, whosoever indulges, must be confirmed in the love of virtue, in a desire to imitate its all-perfect pattern, and in a cheerful security that all his great concerns, those of his friends and of the universe, shall be absolutely safe under the conduct of unerring wisdom and unbounded goodness. It is in his care and providence alone that the good man, who is anxious for the happiness of all, finds perfect serenity; a serenity neither ruffled by partial ill nor soured by private disappointment.

Duty to God.

179 Repentance, &c.

When we consider the unstained purity and absolute perfection of the *divine* nature, and reflect withal on the imperfection and various blemishes of our own, we must sink, or be convinced we ought to sink, into the deepest humility and prostration of soul before him who is so wonderfully great and holy. When, further, we call to mind what low and languid feelings we have of the divine presence and majesty, what insensibility of his fatherly and universal goodness, nay, what ungrateful returns we have made to it, how far we come short of the perfection of his law and the dignity of our own nature, how much we have indulged the selfish passions, and how little we have cherished the benevolent ones; we must be conscious that it is our duty to repent of a temper and conduct so unworthy our nature and unbecoming our obligations to its Author, and to resolve and endeavour to act a wiser and better part for the future.

180 Hopes of pardon.

Nevertheless, from the character which his works exhibit of him, from those delays or alleviations of punishment which offenders often experience, and from the merciful tenor of his administration in many other instances, the sincere penitent may entertain good hopes that his Parent and Judge will not be strict to mark iniquity, but will be propitious and favourable to him, if he honestly endeavours to avoid his former practices, and subdue his former habits, and to live in a greater conformity to the divine will for the future. If any doubts or fears should still remain, how far it may be consistent with the rectitude and equity of the divine government to let his iniquities pass unpunished, yet he cannot think it unsuitable to his paternal clemency and wisdom to contrive a method of retrieving the penitent offender, that shall unite and reconcile the majesty and mercy of his government. If reason cannot of itself suggest such a scheme, it gives at least some ground to expect it. But though *natural religion* cannot let in moral light and assurance on so interesting a subject, yet it will teach the humble theist to wait with great submission for any farther intimations it may please the supreme Governor to give of his will; to examine with candour and impartiality whatever evidence shall be proposed to him of a *divine revelation*, whether that evidence is *natural* or *supernatural*; to embrace it with veneration and cheerfulness, if the evidence is clear and convincing; and, finally, if it bring to light any *new relations* or *connexions*, *natural religion* will persuade its sincere votary faithfully to comply with the *obligations*, and perform the *duties* which result from those relations and connexions. This is *theism*, *piety*, the *completion of morality!*

181 Worship, praise, thanksgiving.

We must farther observe, that all those affections which we supposed to regard the Deity as their *immediate* and *primary* object, are vital energies of the soul, and consequently exert themselves into act, and, like all other energies, gain strength or greater activity by that exertion. It is therefore our *duty* as well as highest *interest*, often at stated times, and by decent and solemn

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lemn acts, to contemplate and adore the great Original of our existence, the Parent of all beauty and of all good; to express our veneration and love by an awful and devout recognition of his perfections; and to evidence our gratitude by celebrating his goodness, and thankfully acknowledging all his benefits. It is likewise our duty, by proper exercises of sorrow and humiliation, to confess our ingratitude and folly; to signify our dependence on God, and our confidence in his goodness, by imploring his blessing and gracious concurrence in assisting the weakness and curing the corruptions of our nature; and, finally, to testify our sense of his authority, and our faith in his government, by devoting ourselves to do his will, and resigning ourselves to his disposal. These duties are not therefore obligatory, because the Deity needs or can be profited by them; but as they are apparently *decent* and *moral*, suitable to the relations he sustains of our *Creator*, *Benefactor*, *Lawgiver*, and *Judge;* expressive of our state and obligations; and improving to our tempers, by making us more rational, social, god-like, and consequently more happy.

182 External worship.

We have now considered INTERNAL piety, or the *worship of the mind*, that which is in spirit and in truth; we shall conclude the section with a short account of that which is EXTERNAL. *External* worship is founded on the same principles as *internal*, and of as strict moral obligation. It is either *private* or *public*. *Devotion* that is *inward* or *purely intellectual*, is too spiritual and abstracted an operation for the bulk of mankind. The operations of their minds, such especially as are employed on the most sublime, immaterial objects, must be assisted by their outward organs, or by some help from the imagination; otherwise they will soon be dissipated by sensible impressions, or grow tiresome if too long continued. Ideas are such fleeting things, that they must be fixed; and so subtle, that they must be expressed and delineated, as it were, by sensible marks and images; otherwise we cannot attend to them, nor be much affected by them. *Therefore*, *verbal adoration*, *prayer*, *praise*, *thanksgiving*, and *confession*, are admirable aids to *inward* devotion, fix our attention, compose and enliven our thoughts, impress us more deeply with a sense of the awful presence in which we are, and, by a natural and mechanical sort of influence, tend to heighten those devout feelings and affections which we ought to entertain, and after this manner reduce into formal and explicit act.

Duty to God.

183 Public worship.

This holds true in a higher degree in the case of *public* worship, where the presence of our fellow-creatures, and the powerful contagion of the *social* affections, conspire to kindle and spread the devout flame with greater warmth and energy. To conclude: As *God* is the *parent* and *head* of the *social system*, as he has formed us for a *social state*, as by *one* we find the best security against the ills of life, and in the *other* enjoy its greatest comforts, and as, by means of *both*, our nature attains its highest improvement and perfection; and moreover, as there are *public blessings* and *crimes* in which we all share in some degree, and *public wants* and *dangers* to which all are exposed—it is therefore evident, that the various and solemn offices of *public religion* are duties of indispensable moral obligation, among the best cements of society, the firmest prop of government, and the fairest ornament of both.

PART III.

CHAP. I. *Of* PRACTICAL ETHICS, *or the* CULTURE *of the* MIND.

184 Dignity and importance of the subject.

WE have now gone through a particular detail of the several duties we owe to OURSELVES, to SOCIETY, and to GOD. In considering the *first order* of duties, we just touched on the methods of acquiring the different kinds of goods which we are led by nature to pursue; only we left the consideration of the method of acquiring the *moral* goods of the mind to a chapter by itself, because of its singular importance. This chapter then will contain a brief enumeration of the arts of acquiring *virtuous habits*, and of eradicating *vicious ones*, as far as is consistent with the brevity of such a work: a subject of the utmost difficulty as well as importance in morals; to which, nevertheless, the least attention has been generally given by *moral* writers. This will properly follow a detail of duty, as it will direct us to such *means* or *helps* as are most necessary and conducive to the practice of it.

185 Sensible ideas and sensible taste.

In the first part of this inquiry we traced the order in which the passions shoot up in the different periods of human life. That order is not accidental or dependent on the caprice of men, or the influence of custom and education, but arises from the original constitution and laws of our nature; of which this is one, viz. "That sensible objects make the first and strongest impressions on the mind." These, by means of our outward organs, being conveyed to the mind, become objects of its attention, on which it reflects when the outward objects are no longer present, or, in other words, when the impressions upon the outward organs cease. These objects of the mind's reflection are called *ideas* or *notions*. Towards these, by another law of our nature, we are not altogether indifferent; but correspondent movements of *desire* or *aversion*, *love* or *hatred*, arise, according as the objects which they denote made an agreeable or disagreeable impression on our organs. Those *ideas* and *affections* which we experience in the *first* period of life, we refer to the *body*, or to *sense;* and the *taste*, which is formed towards them, we call a *sensible*, or a merely *natural taste;* and the objects corresponding to them we in general call *good* or *pleasant*.

186 Ideas of beauty and a fine taste.

But as the mind moves forward in its course, it extends its views, and receives a new and more *complex* set of ideas, in which it observes *uniformity*, *variety*, *similitude*, *symmetry of parts*, *reference to an end*, *novelty*, *grandeur*. These compose a vast train and diversity of *imagery*, which the mind compounds, divides, and moulds into a thousand forms, in the absence of those objects which first introduced it. And this more complicated imagery suggests a new train of *desires* and *affections*,

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affections, full as sprightly and engaging as any which have yet appeared. This whole class of *perceptions* or *impressions* is referred to the *imagination*, and forms a higher taste than the *sensible*, and which has an immediate and mighty influence on the *finer* passions of our nature, and is commonly termed a *fine taste*.

The objects which correspond to this taste we use to call *beautiful*, *great*, *harmonious*, or *wonderful*, or in general by the name of *beauty*.

187 Moral ideas and a moral taste.

The mind, still pushing onwards and increasing its stock of ideas, ascends from those to a higher species of objects, viz. the *order* and *mutual relations* of *minds* to each other, their reciprocal *affections*, *characters*, *actions*, and various *aspects*. In these it discovers a *beauty*, a *grandeur*, a *decorum*, more interesting and alluring than in any of the former kinds. These objects, or the notions of them, passing in review before the mind, do, by a necessary law of our nature, call forth another and nobler set of affections, as *admiration*, *esteem*, *love*, *honour*, *gratitude*, *benevolence*, and others of the like tribe. This class of *perfections*, and their correspondent *affections*, we refer, because of their objects (*manners*), to a *moral* sense, and call the *taste* or *temper* they excite, *moral*. And the objects which are agreeable to this *taste* or *temper* we denominate by the general name of *moral beauty*, in order to distinguish it from the other, which is termed *natural*.

188 Sources of association.

These different sets of *ideas* or *notions* are the materials about which the mind employs itself, which it blends, ranges, and diversifies ten thousand different ways. It feels a strong propension to connect and associate those ideas among which it observes any *similitude* or any *aptitude*, whether *original* and *natural*, or *customary* and *artificial*, to suggest each other. See METAPHYSICS.

189 Laws of association.

But whatever the reasons are, whether *similitude*, *coexistence*, *causality*, or any other *aptitude* or *relation*, why any two or more ideas are connected by the mind at first, it is an established law of our nature, "that when two or more ideas have often started in company, they form so strong an union, that it is very difficult ever after to separate them." Thus the *lover* cannot separate the idea of *merit* from his *mistress*; the *courtier* that of *dignity* from his *title* or *ribbon*; the *miser* that of *happiness* from his *bags*. It is these associations of *worth* or *happiness* with any of the different sets of *objects* or *images* before specified that form our *taste* or *complex idea* of *good*. By another law of our nature, "our *affections* follow and are governed by this *taste*. And to these *affections* our *character* and *conduct* are similar and proportioned on the general tenor of which our *happiness* principally depends."

190 Leading passions follow taste.

As all our *leading* passions then depend on the direction which our *taste* takes, and as it is always of the same strain with our *leading* associations, it is worth while to inquire a little more particularly how these are formed, in order to detect the secret sources from whence our passions derive their principal strength, their various rises and falls. For this will give us the true key to their management, and let us into the right method of correcting the *bad* and improving the *good*.

191 The importance and use of the imagination.

No kind of objects make so powerful an impression on us as those which are immediately impressed on our *senses*, or strongly painted on our *imaginations*. Whatever is purely *intellectual*, as abstracted or scientific truths, the subtle relations and differences of things, has a fainter sort of existence in the mind; and though it may exercise and whet the *memory*, the *judgment*, or the *reasoning power*, gives hardly any impulse at all to the *active* powers, the *passions*, which are the main springs of motion. On the other hand, were the mind entirely under the direction of *sense*, and impressible only by such objects as are present, and strike some of the outward organs, we should then be precisely in the state of the brute creation, and be governed solely by *instinct* or *appetite*, and have no power to controul whatever impressions are made upon us: Nature has therefore endued us with a *middle faculty*, wonderfully adapted to our *mixed* state, which holds partly of *sense* and partly of *reason*, being strongly allied to the *former*, and the common receptacle in which all the notices that come from that quarter are treasured up; and yet greatly subservient and ministerial to the *latter*, by giving a body, a coherence, and beauty to its conceptions. This *middle* faculty is called the *imagination*, one of the most busy and fruitful powers of the mind. Into this common storehouse are likewise carried all those *moral forms* which are derived from our *moral faculties* of perception; and there they often undergo new changes and appearances, by being mixed and wrought up with the ideas and forms of *sensible* or *natural* things. By this coalition of imagery, *natural* beauty is dignified and heightened by *moral qualities* and *perfections*, and *moral qualities* are at once exhibited and set off by *natural beauty*. The *sensible* beauty, or good, is refined from its dross by partaking of the *moral*; and the *moral* receives a stamp, a visible character and currency, from the *sensible*.

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192 Its energy in various instances in heightening sensible pleasures;

As we are first of all accustomed to *sensible* impressions and *sensible* enjoyments, we contract early a *sensual relish* or *love of pleasure*, in the lower sense of the word. In order, however, to justify this relish, the mind, as it becomes open to *higher* perceptions of *beauty* and *good*, borrows from thence a noble set of *images*, as *fine taste*, *generosity*, *social affections*, *friendship*, *good fellowship*, and the like; and, by dressing out the old pursuits with these new ornaments, gives them an additional dignity and lustre. By these ways the *desire of a table*, *love of finery*, *intrigue*, and *pleasure*, are vastly increased beyond their natural pitch, having an impulse combined of the force of the *natural* appetites, and of the superadded strength of those *passions* which tend to the *moral species*. When the mind becomes more sensible to those objects or appearances in which it perceives *beauty*, *uniformity*, *grandeur*, and *harmony*, as fine clothes, elegant furniture, plate, pictures, gardens, houses, equipage, the beauty of animals, and particularly the attractions of the sex; to these objects the mind is led by *nature* or taught by *custom*, the *opinion* and example of others, to annex certain ideas of *moral character*, *dignity*, *decorum*, *honour*, *liberality*, *tenderness*, and *active* or *social enjoyment*. The consequence of this association is, that the objects to which these are annexed must rise in their value, and be pursued with proportionable ardour. The *enjoyment* of them is often attended with *pleasure*; and the mere *possession* of them, where that is wanting, frequently draws respect from one's fellow-creatures: This *respect* is, by many, thought equivalent to the pleasure of *enjoyment*. Hence

193 in heightening the pleasures of beauty, harmony, &c.

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it happens that the idea of *happiness* is connected with the mere *possession*, which is therefore eagerly sought after without any regard to the *generous use* or *honourable enjoyment*. Thus the passion, resting on the *means* not the end, i. e. losing sight of its *natural* object, becomes wild and extravagant.

194 In raising the value of external symbols, &c.

In fine, any *object*, or *external denomination*, a *staff*, a *garter*, a *cup*, a *crown*, *a title*, may become a *moral* badge or emblem of *merit*, *magnificence*, or *honour*, according as these have been found or thought, by the possessors or admirers of them, to accompany them; yet, by the deception formerly mentioned, the *merit* or the *conduct* which entitled, or should entitle to those marks of distinction, shall be forgot or neglected, and the *badges* themselves be passionately affected or pursued, as including every excellency. If these are attained by any means, all the concomitants which *nature*, *custom*, or *accidents* have joined to them, will be supposed to follow of course. Thus, *moral ends* with which the unhappy admirer is apt to colour over his passion and views will, in his opinion, justify the most *immoral means*, as *prostitution*, *adulation*, *fraud*, *treachery*, and every species of *knavery*, whether more open or more disguised.

195 in heightening the value of wealth, power, &c.

When men are once engaged in *active* life, and find that *wealth* and *power*, generally called INTEREST, are the great avenues to every kind of enjoyment, they are apt to throw in many engaging *moral forms* to the object of their pursuit, in order to justify their passion, and varnish over the measures they take to gratify it, as *independency on the vices* or *passions* of others, *provision* and *security to themselves* and *friends*, *prudent economy* or *well-placed charity*, *social communication*, *superiority to their enemies*, who are all villains, *honourable service*, and many other ingredients of *merit*. To attain such capacities of *usefulness* or *enjoyment*, what arts, nay what meannesses, can be thought blameable by those cool pursuers of interest?—Nor have they whom the gay world is pleased to indulge with the title of *men of pleasure*, their imaginations less pregnant with *moral images*, with which they never fail to ennoble, or, if they cannot do that, to palliate their gross pursuits. Thus *admiration of wit*, of *sentiments* and *merit*, *friendship*, *love*, *generous sympathy*, *mutual confidence*, *giving* and *receiving pleasure*, are the ordinary ingredients with which they season their gallantry and pleasurable entertainments; and by which they impose on themselves, and endeavour to impose on others, that *their amours* are the joint issue of good sense and virtue.

196 Its influence on all the passions.

These *associations*, variously combined and proportioned by the *imagination*, form the chief *private* passions, which govern the lives of the generality, as the *love of action*, of *pleasure*, *power*, *wealth*, and *fame*; they influence the *defensive*, and affect the *public passions*, and raise *joy* or *sorrow* as they are gratified or disappointed. So that in effect these associations of *good* and *evil*, *beauty* and *deformity*, and the passions they raise, are the main *hinges of life* and *manners*, and the great *sources* of our *happiness* or *misery*. It is evident, therefore, that the whole of *moral culture* must depend on giving a right direction to the *leading passions*, and duly proportioning them to the *value* of the *objects* or *goods* pursued, under what name soever they may appear.

Now, in order to give them this *right direction* and *due proportion*, it appears from the foregoing detail, that those *associations* of ideas, upon which the passions depend, must be *duly* regulated; that is to say, as an exorbitant passion for *wealth*, *pleasure*, or *power*, flows from an *association* or *opinion*, that more *beauty* and *good*, whether *natural* or *moral*, enters into the enjoyment or possession of them, than really belongs to either; *therefore*, in restoring those passions to their just proportion, we must begin with correcting the *opinion*, or breaking the *false association*, or, in other words, we must decompound the *complex phantom* of *happiness* or *good*, which we fondly admire; dismite those ideas that have no natural alliance; and separate the *original* idea of *wealth*, *power*, or *pleasure*, from the foreign mixtures, incorporated with it, which enhance its value, or give it its chief power to enchant and seduce the mind. For instance, let it be considered how poor and inconsiderable a thing *wealth* is, if it be disjoined from *real use*, or from ideas of *capacity* in the possessor to *do good*, from *independence*, *generosity*, *provision for a family* or *friends*, and *social communication* with others. By this *standard* let its true value be fixed; let its misapplication, or unbenevolent enjoyment, be accounted sordid and infamous; and nothing worthy or estimable be ascribed to the *mere possession* of it, which is not borrowed from its *generous use*.

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197 Moral culture, by correcting our taste of imaginations;

198 by self-denial, and a counter-process;

If that *complex* form of *good* which is called *pleasure* engage us, let it be analyzed into its constituent principles, or those allurements it draws from the *heart* and *imagination*, in order to heighten the low part of the indulgence; let the *separate* and *comparative* moment of each be distinctly ascertained and deduced from that gross part, and this remainder of the accumulated enjoyment will dwindle down into a poor, insipid, transitory thing. In proportion as the *opinion* of the *good* pursued abates, the *admiration* must decay, and the *passions* lose strength of course. One effectual way to lower the *opinion*, and consequently to weaken the habit founded upon it, is to practise lesser pieces of self-denial, or to abstain, to a certain pitch, from the pursuit or enjoyment of the favourite object; and, that this may be the more easily accomplished, one must avoid those occasions, that company, those places, and the other circumstances, that inflamed *one* and endeared the *other*. And, as a *counter-process*, let *higher* or even *different* enjoyments be brought in view, other passions played upon the former, different places frequented, other exercises tried, company kept with persons of a different or more correct way of thinking both in *natural* and *moral* subjects.

199 by a sound and natural education.

As much depends on our setting out well in life, let the *youthful* fancy, which is apt to be very florid and luxuriant, be early accustomed by *instruction*, *example*, and significant *moral exercises*, nay, by looks, gestures, and every other testimony of just approbation or blame, to annex ideas of *merit*, *honour*, and *happiness*, not to *birth*, *dress*, *rank*, *beauty*, *fortune*, *power*, *popularity*, and the like *outward* things, but to *moral* and *truly virtuous qualities*, and to those *enjoyments* which spring from a well-informed judgment and a regular conduct of the affections, especially those of the *social* and *disinterested* kind. Such dignified forms of *beauty* and *good*, often suggested, and, by moving pictures and examples warmly recommended to the *imagination*, enforced by the authority of conscience, and demonstrated by reason to be

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the surest means of enjoyment, and the only independent, undeprivable, and durable goods, will be the best counterbalance to meaner passions, and the firmest foundation and security of virtue.

200 by rightly studying human nature;

It is of great importance to the forming a *just taste*, or pure and large conceptions of happiness, to study and understand *human nature* well, to remember what a complicated system it is, particularly to have deeply imprinted on our mind that GRADATION of *senses*, *faculties*, and *powers of enjoyment* formerly mentioned, and the *subordination of goods* resulting from thence, which nature points out, and the experience of mankind confirms. Who, when they think seriously and are not under the immediate influence of some violent prejudice or passion, prefer not the pleasures of *action*, *contemplation*, *society*, and most *exercises* and *joys* of the *moral* kind, as *friendship*, *natural affection*, and the like, to all *sensual* gratifications whatsoever? Where the different species of pleasure are blended into *one complex form*, let them be accurately distinguished, and be referred each to its proper *faculty* and *sense*, and examined apart what they have peculiar, what common with others, and what foreign and adventitious. Let *wealth*, *grandeur*, *luxury*, *love*, *fame*, and the like, be tried by this test, and their true alloy will be found out. Let it be further considered, whether the mind may not be easy and enjoy itself greatly, though it want many of those elegancies and superfluities of life which some possess, or that load of wealth and power which others eagerly pursue, and under which they groan. Let the difficulty of attaining, the precariousness of possessing, and the many abatements in enjoying overgrown wealth and envied greatness, of which the weary possessors so frequently complain, as the hurry of business, the burden of company, of paying attendance to the *few*, and giving it to *many*, the cares of keeping, the fears of losing, and the desires of increasing what they have, and the other troubles which accompany this pitiful drudgery and pompous servitude; let these and the like circumstances be often considered, that are conducive to the removing or lessening the *opinion* of such goods, and the attendant *passion* or *set* of *passions* will decay of course.

201 by comparing the moment and abatements of different goods;

202 by observing our own bent and character, &c.

Let the peculiar bent of our nature and character be observed, whether we are most inclined to form associations and relish objects of the *sensible*, *intellectual*, or *moral* kind. Let that which has the ascendant be particularly watched; let it be directed to right objects, be improved by proportioned exercises, and guarded by proper checks from an opposite quarter. Thus the *sensible* turn may be exalted by the *intellectual*, and a taste for the beauty of the *fine arts*, and both may be made subservient to convey and rivet sentiments highly *moral* and *public-spirited*. This inward survey must extend to the *strength* and *weaknesses* of one's *nature*, one's *conditions*, *connexions*, *habitudes*, *fortunes*, *studies*, *acquaintance*, and the other circumstances of one's life, from which every man will form the justest estimate of his own dispositions and character, and the best rules for correcting and improving them. And in order to do this with more advantage, let those *times* or *critical seasons* be watched when the mind is best disposed towards a change; and let them be improved by rigorous *resolutions*, *promises*, or whatever else will engage the mind to persevere in virtue. Let the *conduct*, in fine, be often reviewed, and the *causes* of its *corruption* or *improvement* be carefully observed.

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203 by frequent moral exercises;

It will greatly conduce to refine the *moral taste* and strengthen the *virtuous temper*, to accustom the mind to the frequent exercise of *moral sentiments* and *determinations*, by reading *history*, *poetry*, particularly of the *picturesque* and *dramatic* kind, the study of the *fine arts*; by conversing with the most eminent for good sense and virtue; but above all, by frequent and repeated acts of *humanity*, *compassion*, *friendship*, *politeness*, and *hospitality*. It is exercise that gives health and strength. He that reasons most frequently becomes the wisest, and most enjoys the pleasures of wisdom. He who is most often affected by objects of compassion in poetry, history, or real life, will have his soul most open to pity, and its delightful pains and duties. So he also who practices most diligently the offices of kindness and charity, will by it cultivate that disposition from whence all his pretensions to personal merit must arise, his present and his future happiness.

204 by an honest employment;

An useful and honourable employment in life will administer a thousand opportunities of this kind, and greatly strengthen a sense of virtue and good affections, which must be nourished by light training, as well as our understandings. For such an employment, by enlarging one's experience, giving a habit of attention and caution, or obliging one, from necessity or interest, to keep a guard over the passions, and study the outward decencies and appearances of virtue, will by degrees produce good habit, and at length insinuate the love of virtue and honesty for its own sake.

205 by viewing men and manners in a fair light;

It is a great inducement to the exercise of benevolence to view *human nature* in a favourable light, to observe the characters and circumstances of mankind on the *fairest* sides, to put the best constructions on their actions they will bear, and to consider them as the result of *partial* and *mistaken* rather than *ill* affections, or, at worst, as the excesses of a pardonable self-love, seldom or never the effect of pure malice.

206 by consideration and pious exercises;

Above all, the *nature* and *consequences* of *virtue* and *vice*, their consequences being the law of our nature and will of heaven; the light in which they appear to our supreme *Parent* and *Lawgiver*, and the reception they will meet with from him, must be often attended to. The exercises of *piety*, as *adoration* and *praise* of the *divine* excellency, *invocation* of and *dependence* on his aid, *confession*, *thanksgiving*, and *resignation*, are habitually to be indulged, and frequently performed, not only as *medicinal*, but highly *improving* to the temper.

207 by just views of human life, and its connexion with a future.

To conclude: It will be of admirable efficacy towards eradicating *bad* habits, and implanting *good* ones, frequently to contemplate *human life* as the great *nursery* of our *future* and *immortal existence*, as that *state of probation* in which we are to be *educated* for a *divine life*; to remember, that our *virtues* or *vices* will be *immortal* as ourselves, and influence our *future* as well as our *present* happiness—and therefore, that every disposition and action is to be regarded as pointing beyond the *present* to an *immortal* duration.—An habitual attention to this wide and important *connexion* will give a vast compass and dignity to our sentiments and actions, a no-

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ble superiority to the pleasures and pains of life, and a generous ambition to make our *virtue* as *immortal as* our *being*.

Chap. II. *Motives to* Virtue *from Personal* Happiness.

208 Motives from personal happiness.

We have already considered our *obligations* to the practice of *virtue*, arising from the *constitution* of our nature, by which we are led to *approve* a certain *order* and *economy* of *affections*, and a certain *course of action* correspondent to it*. But, besides this, there are several motives which strengthen and secure virtue, though not themselves of a *moral* kind. These are, its *tendency to personal happiness* and the *contrary tendency of vice*. "Personal happiness arises either from the state of a man's own mind, or from the state and disposition of external causes towards him."

* *Vide* Part I. chap. i. ii. &c.

209 Happiness of virtue from within.

We shall first examine the "tendency of virtue to happiness with respect to the state of a man's own mind." This is a point of the utmost consequence in morals, because, unless we can convince ourselves, or show to others, that, by doing our *duty*, or fulfilling our *moral obligations*, we consult the greatest satisfaction of our own mind, or our highest interest on the whole, it will raise strong and often unsurmountable prejudices against the practice of virtue, especially whenever there arise any appearances of *opposition* between our *duty* and our *satisfaction* or *interest*. To creatures so desirous of happiness, and averse to misery, as we are, and often so oddly situated amidst contending passions and interests, it is necessary that virtue appear not only an *honourable* but a *pleasing* and *beneficent* form. And in order to justify our choice to ourselves as well as before others, we must ourselves feel and be able to avow in the face of the whole world, that her ways are ways of pleasantness, and her paths the paths of peace. This will show, beyond all contradiction, that we not only approve, but can give a sufficient reason for what we do.

210 Influence of vice on the temper of the mind.

Let any man in a cool hour, when he is disengaged from business, and undisturbed by passion (as such cool hours will sometimes happen), sit down, and seriously reflect with himself what state or temper of mind he would choose to feel and indulge, in order to be easy and to enjoy himself. Would he choose, for that purpose, to be in a constant dissipation and hurry of thought; to be disturbed in the exercise of his reason; to have various and often interfering phantoms of good playing before his imagination, soliciting and distracting him by turns, now soothing him with amusing hopes, then torturing him with anxious fears; and to approve this minute what he shall condemn the next? Would he choose to have a strong and painful sense of every petty injury; quick apprehensions of every impending evil; incessant and insatiable desires of power, wealth, honour, pleasure; an irreconcilable antipathy against all competitors and rivals; insolent and tyrannical dispositions to all below him; fawning, and at the same time envious, dispositions to all above him; with dark suspicions and jealousies of every mortal? Would he choose neither to love nor be beloved of any; to have no friend in whom to confide, or with whom to interchange his sentiments or designs; no favourite, on whom to bestow his kindness, or vent his passions; in fine, to be conscious of no merit with mankind, no esteem from any creature, no good affection to his Maker, no concern for, nor hopes of, his approbation; but instead of all these, to hate, and know that he is hated, to condemn, and know that he is condemned by all; by the good, because he is so unlike; and by the bad because he is so like themselves; to hate or to dread the very Being that made him; and, in short, to have his breast the seat of pride and passion, petulance and revenge, deep melancholy, cool malignity, and all the other furies that ever possessed and tortured mankind?—Would our calm inquirer after happiness pitch on such a state, and such a temper of mind, as the most likely means to put him in possession of his desired ease and self-enjoyment?

From Happiness.

211 Influence of virtue on the temper.

Or would he rather choose a serene and easy flow of thought; a reason clear and composed; a judgment unbiassed by prejudice, and undistracted by passion; a sober and well-governed fancy, which presents the images of things true, and unmixed with delusive and unnatural charms, and therefore administers no improper or dangerous fuel to the passions, but leaves the mind free to choose or reject, as becomes a reasonable creature; a sweet and sedate temper, not easily ruffled by hopes or fears, prone neither to suspicion nor revenge, apt to view men and things in the fairest lights, and to bend gently to the humours of others rather than obstinately to contend with them? Would he choose such moderation and continence of mind, as neither to be ambitious of *power*, fond of *honours*, covetous of *wealth*, nor a slave to *pleasure*; a mind of course neither elated with success, nor dejected with disappointment; such a modest and noble spirit as supports power without insolence, wears honour without pride, uses wealth without profusion or parsimony; and rejoices more in giving than in receiving pleasure; such fortitude and equanimity as rises above misfortunes, or turns them into blessings; such integrity and greatness of mind, as neither flatters the vices, nor triumphs over the follies of men; as equally spurns servitude and tyranny, and will neither engage in low designs, nor abet them in others? Would he choose, in fine, such mildness and benignity of heart as takes part in all the joys, and refuses none of the sorrows, of others; stands well affected to all mankind; is conscious of meriting the esteem of all, and of being beloved by the best; a mind which delights in doing good without any show, and yet arrogates nothing on that account; rejoices in loving and being beloved by its Maker, acts ever under his eye, resigns itself to his providence, and triumphs in his approbation? Which of these dispositions would be his choice in order to be contented, serene, and happy? The *former* temper is VICE, the *latter* VIRTUE. Where *one* prevails, there MISERY prevails, and by the generality is acknowledged to prevail. Where the *other* reigns, there HAPPINESS reigns, and by the confession of mankind is acknowledged to reign. The *perfection* of either temper is *misery* or *happiness in perfection*.—THEREFORE, every *approach* to *either extreme* is an *approach to misery* or to *happiness*; i. e. every *degree* of *vice* or *virtue* is accompanied with a *proportionable degree* of *misery* or *happiness*.

212 The alleviations of his ills.

The principal alleviations of a virtuous man's calamities are these;—That though some of them may have

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have been the effect of his imprudence or weakness, yet few of them are sharpened by a sense of guilt, and none them by a consciousness of wickedness, which surely is their keenest sting;—that they are common to him with the best of men;—that they seldom or never attack him quite unprepared, but rather guarded with a consciousness of his own sincerity and virtue, with a faith and trust in Providence, and a firm resignation to its perfect orders;—that they may be improved as means of correction, or materials to give scope and stability to his virtues;—and, to name no more, they are considerably lessened, and often sweetened to him, by the general sympathy of the wise and good.

213 His enjoyments.

His enjoyments are more numerous, or, if less numerous, yet more intense than those of the bad man: for he shares in the joys of others by rebound; and every increase of *general* or *particular* happiness is a real addition to his own. It is true, his friendly *sympathy* with others subjects him to some pains which the hard-hearted wretch does not feel; yet to give a loose to it, is a kind of agreeable discharge. It is such a sorrow as he loves to indulge: a sort of pleasing anguish that sweetly melts the mind, and terminates in a self-approving joy. Though the good man may want means to execute, or be disappointed in the success of, his benevolent purposes; yet, as was formerly † observed, he is still conscious of good affection, and that consciousness is an enjoyment of a more delightful savour than the greatest triumphs of successful vice. If the *ambitious*, *covetous*, or *voluptuous*, are disappointed, their passions recoil upon them with a fury proportioned to their opinion of the value of what they pursue, and their hope of success; while they have nothing within to balance the disappointment, unless it is an useless fund of pride, which, however, *frequently* turns mere accidents into mortifying affronts, and exalts grief into rage and frenzy. Whereas the meek, humble, and benevolent temper, is its own reward, is satisfied from within; and, as it magnifies greatly the pleasure of success, so it wonderfully alleviates, and in a manner annihilates, all pain for the want of it.

† *See* Part II. chap. ii.

214 From merited esteem and sympathy.

As the good man is conscious of loving and wishing well to all mankind, he must be sensible of his deserving the esteem and good-will of all; and this supposed reciprocation of social feelings is, by the very frame of our nature, made a source of very intense and enlivening joys. By this sympathy of affections and interests, he feels himself intimately united with the human race; and, being sensibly *alive* over the whole system, his heart receives and becomes responsive to every touch given to any part. So that, as an eminent *philosopher* * finely expresses it, he gathers contentment and delight from the pleased and happy states of those around him, from accounts and relations of such happiness, from the very countenances, gestures, voices, and sounds, even of creatures foreign to our kind, whose signs of joy and contentment he can any way discern.

* *Vide* Shaftesb. *Inq into Virtue* Book II.

215 Do not interfere with other joys.

Nor do those generous affections stop any other natural source of joy whatever, or deaden his sense of any innocent gratification. They rather keep the several *senses* and *powers of enjoyment* open and disengaged, intense and uncorrupted by riot or abuse; as is evident to any one who considers the dissipated, unfeeling state of men of *pleasure*, *ambition*, or *interest*, and compares it with the serene and gentle state of a mind at peace with itself, and friendly to all mankind, unruffled by any violent emotion, and sensible to every good-natured and alluring joy.

From Happiness.

216 The misery of excess in the private passions.

It were easy, by going through the different sets of affections mentioned formerly †, to show, that it is only by maintaining the proportion settled there, that the mind arrives at true repose and satisfaction. If *fear* exceeds that proportion, it sinks into melancholy and dejection. If *anger* passes just bounds, it ferments into rage and revenge, or subsides into a sullen corroding gloom, which embitters every good, and renders one exquisitely sensible to every ill. The *private* passions, the *love of honour* especially, whose impulses are more generous, as its effects are more diffusive, are instruments of private pleasure; but if they are disproportioned to our *wants*, or to the *value* of their several objects, or to the *balance* of other passions equally necessary and more amiable, they become instruments of intense pain and misery. For, being now destitute of that counterpoise which held them at a due pitch, they grow turbulent, peevish, and revengeful, the cause of constant restlessness and torment, sometimes flying out into a wild delirious joy, at other times settling in a deep splenetic grief. The concert between reason and passion is then broke: all is dissonance and distraction within. The mind is out of frame, and feels an agony proportioned to the violence of the reigning passion.

† *See* Part I. chap. i. ii.

217 In the public affection.

The case is much the same, or rather worse, when any of the particular *kind* affections are out of their natural order and proportion; as happens in the case of *effeminate pity*, *exorbitant love*, *parental dotage*, or any *party passion*, where the just regards to society are supplanted. The more *social* and *disinterested* the passion is, it breaks out into the wilder excesses, and makes the more dreadful havock both within and abroad; as is but too apparent in those cases where a false species of *religion*, *honour*, *zeal*, or *party-rage*, has seized on the natural enthusiasm of the mind, and worked it up to madness. It breaks through all ties *natural* and *civil*, disregards the most sacred and solemn obligations, silences every other affection whether *public* or *private*, and transforms the most gentle natures into the most savage and inhuman.

218 Happiness of well proportioned passions.

Whereas, the man who keeps the *balance* of *affection* even, is easy and serene in his motions; mild, and yet affectionate; uniform and consistent with himself: is not liable to disagreeable collisions of interests and passions; gives always place to the most friendly and humane affections, and never to dispositions or acts of resentment, but on high occasions, when the *security* of the *private*, or *welfare* of the *public* system, or the *great interests* of mankind, necessarily require a noble indignation; and even then he observes a just measure in wrath; and last of all, he proportions every passion to the value of the object he affects, or to the importance of the end he pursues.

219 Sum of the argument.

To sum up this part of the argument, the *honest* and *good* man has eminently the advantage of the *knavish* and *selfish* wretch in every respect. The pleasures which the *last* enjoys flow chiefly from external advantages and gratifications; are superficial and transitory; dashed with long intervals of satiety, and frequent

quent

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quent returns of remorse and fear; dependent on favourable accidents and conjunctures; and subjected to the humours of men. But the *good* man is satisfied from himself; his principal possessions lie within, and therefore beyond the reach of the caprice of men or fortune; his enjoyments are exquisite and permanent; accompanied with no inward checks to damp them, and always with ideas of dignity and self-approbation; may be tasted at any time, and in any place. The gratifications of *vice* are turbulent and unnatural, generally arising from the relief of passions in themselves intolerable, and issuing in tormenting reflection; often irritated by disappointment, always inflamed by enjoyment, and yet ever cloyed with repetition. The pleasures of *virtue* are calm and natural; flowing from the exercise of kind affections, or delightful reflections in consequence of them; not only agreeable in the prospect, but in the present feeling; they never satiate nor lose their relish; nay, rather the admiration of virtue grows stronger every day; and not only is the desire but the enjoyment heightened by every new gratification; and, unlike to most others, it is increased, not diminished, by sympathy and communication.—In fine, the satisfactions of *virtue* may be purchased without a bribe, and possessed in the humblest as well as the most triumphant fortune; they can bear the strictest review, do not change with circumstances, nor grow old with time. Force cannot rob, nor fraud cheat us of them; and, to crown all, instead of abating, they enhance every other pleasure.

220 External effects of virtue.

But the happy consequences of *virtue* are seen not only in the internal enjoyments it affords a man, but "in the favourable disposition of external causes towards him, to which it contributes."

221 On the body.

As *virtue* gives the sober possession of one's self, and the command of one's passions, the consequence must be heart's ease, and a fine natural flow of spirits, which conduce more than any thing else to health and long life. Violent passions, and the excesses they occasion, gradually impair and wear down the machine. But the calm placid state of a temperate mind, and the healthful exercises in which *virtue* engages her faithful votaries, preserve the natural functions in full vigour and harmony, and exhilarate the spirits, which are the chief instruments of action.

222 On one's fortune, interest, &c.

It may by some be thought odd to assert, that *virtue* is no enemy to a man's *fortune* in the present state of things.—But if by *fortune* be meant a moderate or competent share of *wealth*, *power*, or *credit*, not overgrown degrees of them; what should hinder the virtuous man from obtaining that? He cannot cringe or fawn, it is true, but he can be civil and obliging as well as the knave; and surely his civility is more alluring, because it has more manliness and grace in it than the mean adulation of the other: he cannot cheat or undermine; but he may be cautious, provident, watchful of occasions, and equally prompt with the rogue in improving them: he scorns to prostitute himself as a pander to the passions, or as a tool to the vices of mankind; but he may have as sound an understanding and as good capacities for promoting their real interests as the veriest court slave: and then he is more faithful and true to those who employ him. In the common course of business, he has the same chances with the knave of acquiring a fortune, and rising in the world. He may have equal abilities, equal industry, equal attention to business; and in other respects he has greatly the advantage of him. People love better to deal with him; they can trust him more; they know he will not impose on them, nor take advantage of them, and can depend more on his word than on the oath or strongest securities of others. Whereas what is commonly called *cunning*, which is the *offspring of ignorance*, and constant *companion* of *knavery*, is not only a mean-spirited, but a very short-sighted talent, and a fundamental obstacle in the road of business. It may indeed procure immediate and petty gains; but it is attended with dreadful abatements, which do more than overbalance them, both as it sinks a man's credit when discovered, and cramps that largeness of mind which extends to the remotest as well as the nearest interest, and takes in the most durable equally with the most transient gains. It is therefore easy to see how much a man's *credit* and *reputation*, and consequently his success, depend on his honesty and virtue. From Happiness.

223 On one's peace and security.

With regard to *security* and *peace* with his neighbours, it may be thought, perhaps, that the man of a quiet forgiving temper, and a flowing benevolence and courtesy, is much exposed to injury and affronts from every proud or peevish mortal, who has the power or will to do mischief. If we suppose, indeed, this *quietness* and *gentleness* of nature accompanied with *cowardice* and *pusillanimity*, this may often be the case; but in reality the good man is bold as a lion, and so much the bolder for being the calmer. Such a person will hardly be a butt to mankind. The ill natured will be afraid to provoke him, and the good natured will not incline to do it. Besides, *true virtue*, which is conducted by reason, and exerted gracefully and without parade, is a most insinuating and commanding thing; if it cannot disarm malice and resentment at once, it will wear them out by degrees, and subdue them at length. How many have, by favours and prudently yielding, triumphed over an enemy, who would have been inflamed into tenfold rage by the fiercest opposition! In fine, *goodness* is the most universally popular thing that can be.

224 On one's family.

To conclude; the good man may have some enemies, but he will have more friends; and, having given so many marks of private friendship or public virtue, he can hardly be destitute of a patron to protect, or a sanctuary to entertain him, or to protect or entertain his children when he is gone. Though he should have little else to leave them, he bequeaths them the fairest, and generally the most unenvied, inheritance of a *good name*, which, like good seed sown in the field of futurity, will often raise up unsolicited friends, and yield a benevolent harvest of unexpected charities. But should the fragrance of the parent's virtue prove offensive to a perverse or envious age, or even draw persecution on the friendless orphans, there is *one* in heaven who will be more than a father to them, and recompense their parent's virtues by showering down blessings on them.

Chap. III. *Motives to* Virtue *from the* Being *and* Providence *of* God.

225 Two external motives to virtue.

Besides the interesting motive mentioned in the last Chapter, there are two great motives of *virtue*, strictly

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strictly connected with *human life*, and resulting from the very *constitution* of the *human mind*. The first is the BEING and PROVIDENCE of GOD; the second is the IMMORTALITY of the SOUL, with *future rewards* and *punishments*.

226 Their importance.

It appears from Chap. IV. of Part II. that *man*, by the *constitution* of his nature, is designed to be a RELIGIOUS CREATURE. He is intimately connected with the *Deity*, and necessarily dependent on him. From that *connexion* and necessary *dependence* result various *obligations* and *duties*, without fulfilling which, some of his sublimest powers and affections would be incomplete and abortive. If he be likewise an IMMORTAL creature, and if his *present conduct* shall affect his *future happiness* in *another* state as well as in the *present*, it is evident that we take only a *partial view* of the *creature*, if we leave out this important property of his nature; and make a *partial estimate of human life*, if we strike out of the account, or overlook, that part of his duration which runs out into eternity.

227 Piety,

It is evident from the above-mentioned Chapter, that "to have a respect to the *Deity* in our temper and conduct, to *venerate* and *love* his *character*, to *adore* his *goodness*, to *depend upon* and *resign* ourselves to his *providence*, to *seek* his *approbation*, and *act* under a *sense* of his *authority*, is a *fundamental part* of *moral virtue*, and the *completion* of the *highest destination* of *our nature*."

228 a support to virtue;

But as *piety* is an essential part of virtue, so likewise it is a *great support* and *enforcement* to the practice of it. To contemplate and admire a Being of such transcendent dignity and perfection as GOD, must naturally and necessarily open and enlarge the mind, give a freedom and ampleness to its powers, and a grandeur and elevation to its aims. For, as an excellent *divine* observes, "the greatness of an object, and the excellency of the act of any AGENT about a transcendent object, doth mightily tend to the enlargement and improvement of his faculties." Little objects, mean company, mean cares, and mean business, cramp the mind, contract its views, and give it a creeping air and deportment. But when it soars above mortal cares and mortal pursuits into the regions of divinity, and converses with the greatest and best of Beings, it spreads itself into a wider compass, takes higher flights in reason and goodness, becomes godlike in its air and manners. *Virtue* is, if one may say so, both the *effect* and *cause* of largeness of mind. It requires that one think freely, and act nobly. Now what can conduce more to freedom of thought and dignity of action, than to conceive worthily of GOD, to reverence and adore his unrivalled excellency, to imitate and transcribe that excellency into our own nature, to remember our relation to him, and that we are the images and representatives of his glory to the rest of the creation? Such feelings and exercises must and will make us scorn all actions that are base, unhandsome, or unworthy our state; and the relation we stand in to GOD will irradiate the mind with the light of wisdom, and ennoble it with the liberty and dominion of virtue.

229 a guard and enforcement to virtue.

The influence and efficacy of *religion* may be considered in another light. We all know that the presence of a friend, a neighbour, or any number of spectators, but especially an august assembly of them, uses to be a considerable check upon the conduct of one who is not lost to all sense of honour and shame, and contributes to restrain many irregular sallies of passion. In the same manner we may imagine, that the awe of some superior mind, who is supposed privy to our secret conduct, and armed with full power to reward or punish it, will impose a restraint on us in such actions as fall not under the controul or animadversion of others. If we go still higher, and suppose our inmost thoughts and darkest designs, as well as our most secret actions, to lie open to the notice of the supreme and universal Mind, who is both the *spectator* and *judge* of human actions, it is evident that the belief of so august a presence, and such awful inspection, must carry a restraint and weight with it proportioned to the strength of that belief, and be an additional motive to the practice of many duties which would not have been performed without it.

From the Immortality of the Soul.

230 Exercises of piety improving to virtue.

It may be observed farther, that "to live under an habitual sense of the *Deity* and his great *administration*, is to be conversant with *wisdom*, *order*, and *beauty*, in the highest subjects, and to receive the delightful reflexions and benign feelings which these excite while they irradiate upon him from every scene of nature and providence." How improving must such views be to the mind, in dilating and exalting it above those puny interests and competitions which agitate and inflame the bulk of mankind against each other!

CHAP. IV. *Motive to* VIRTUE *from the* IMMORTALITY *of the* SOUL, *&c.*

231 Metaphysical arguments for its immortality.

THE other motive mentioned was the *immortality* of the soul, with *future rewards* and *punishments*. The *metaphysical* proofs of the soul's immortality are commonly drawn from—its *simple*, *uncompounded*, and *indivisible* nature; from whence it is concluded, that it cannot be corrupted or extinguished by a dissolution or destruction of its parts:—from its having a *beginning* of *motion* within itself; whence it is inferred, that it cannot discontinue and lose its motion:—from the different properties of *matter* and *mind*, the *sluggishness* and *inactivity* of the *one*, and the immense *activity* of the *other*, its prodigious flight of *thought* and *imagination*; its *penetration*, *memory*, *foresight*, and *anticipations* of *futurity*; from whence it is concluded, that a being of so divine a nature cannot be extinguished. But as these metaphysical proofs depend on intricate reasonings concerning the *nature*, *properties*, and *distinctions* of *body* and *mind*, with which we are not very well acquainted, they are not obvious to ordinary understandings, and are seldom so convincing even to those of higher reach, as not to leave some doubts behind them. Therefore perhaps it is not so safe to rest the proof of such an important article on what many may call the subtilities of school learning. Those proofs which are brought from *analogy*, from the *moral constitution* and *phenomena* of the *human mind*, the *moral attributes* of God, and the *present course of things*, and which therefore are called the *moral* arguments, are the plainest and generally the most satisfying. We shall select only one or two from the rest.

232 Moral proof from analogy.

In tracing the *nature* and *destination* of any being, we form the surest judgment from his *powers* of *action*, and the scope and *limits* of these, compared with his *state*,

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state, or with that *field* in which they are exercised. If this being passes through different states, or fields of action, and we find a *succession* of powers adapted to the different periods of his progress, we conclude that he was destined for those successive states, and reckon his nature *progressive*. If, besides the immediate set of powers which fit him for action in his present state, we observe another set which appear superfluous if he were to be confined to it, and which point to another or higher one, we naturally conclude, that he is not designed to remain in his present state, but to advance to that for which those supernumerary powers are adapted. Thus we argue, that the *insect*, which has wings forming or formed, and all the apparatus proper for flight, is not destined always to creep on the ground, or to continue in the torpid state of adhering to a wall, but is designed in its season to take its flight in air. Without this farther destination, the admirable mechanism of wings and the other apparatus would be useless and absurd. The same kind of reasoning may be applied to man, while he lives only a sort of *vegetative* life in the womb. He is furnished even there with a beautiful apparatus of organs, eyes, ears, and other delicate senses, which receive nourishment indeed, but are in a manner folded up, and have no proper exercise or use in their present confinement *. Let us suppose some intelligent spectator, who never had any connexion with man, nor the least acquaintance with human affairs, to see this odd phenomenon, a creature formed after such a manner, and placed in a situation apparently unsuitable to such various machinery: must he not be strangely puzzled about the use of his complicated structure, and reckon such a profusion of art and admirable workmanship lost on the subject; or reason by way of anticipation, that a creature endued with such various yet unexerted capacities, was destined for a more enlarged sphere of action, in which those latent capacities shall have full play? the vast variety and yet beautiful symmetry and proportions of the several parts and organs with which the creature is endued, and their apt cohesion with, and dependence on, the curious receptacle of their life and nourishment, would forbid his concluding the whole to be the birth of chance, or the bungling effort of an unskilful artist; at least would make him demur a while at so harsh a sentence. But if, while he is in this state of uncertainty, we suppose him to see the babe, after a few successful struggles, throwing off his fetters, breaking loose from his little dark prison, and emerging into open day, then unfolding his recluse and dormant powers, breathing in air, gazing at light, admiring colours, sounds, and all the *fair variety* of nature, immediately his doubts clear up, the propriety and excellency of the workmanship dawn upon him with full lustre, and the whole mystery of the first period is unravelled by the opening of this new scene. Though in this *second* period the creature lives chiefly a kind of *animal life*, i. e. of *sense* and *appetite*, yet by various trials and observations he gains experience, and by the gradual evolution of the powers of *imagination* he ripens apace for a *higher* life, for exercising the arts of *design* and *imitation*, and of those in which strength or dexterity are more requisite than acuteness or reach of judgment. In the succeeding *rational* or *intellectual* period, his *understanding*, which formerly crept in a lower, mounts into a higher sphere, canvasses the natures, judges of the relations of things, forms schemes, deduces consequences from what is past, and from present as well as past collects future events. By this succession of states, and of correspondent culture, he grows up at length into a *moral*, a *social*, and a *political* creature. This is the last period at which we perceive him to arrive in this his mortal career. Each *period* is introductory to the next succeeding one; each *life* is a field of exercise and improvement for the next higher one; the life of the *fœtus* for that of the *infant*, the life of the *infant* for that of the *child*, and all the lower for the highest and best §.—But is this the last period of nature's progression? Is this the utmost extent of her plot, where she winds up the drama, and dismisses the actor into eternal oblivion? Or does he appear to be invested with supernumerary powers, which have not full exercise and scope even in the last scene, and reach not that maturity or perfection of which they are capable; and therefore point to some higher scene, where he is to sustain another and more important character than he has yet sustained? If any such there are, may we not conclude by analogy, or in the same way of anticipation as before, that he is destined for that after part, and is to be produced upon a more august and solemn stage, where his sublimer powers shall have proportioned action, and his nature attain its completion.

From the Immortality of the Soul.

§ *See* Butler's *Analogy*, Part I.

* *Vide* Ludov. Viv. *de Relig. Christ.* Lib. II. *de vita Uteri*, &c.

233 Powers in man which point to an after-life.

If we attend to that *curiosity*, or prodigious *thirst* of *knowledge*, which is natural to the mind in every period of its progress, and consider withal the endless round of business and care, and the various hardships to which the bulk of mankind are chained down; it is evident, that in this present state it is impossible to expect the gratification of an appetite at once so insatiable and so noble. Our *senses*, the ordinary organs by which knowledge is let into the mind, are always imperfect, and often fallacious; the advantages of assisting or correcting them are possessed by few; the difficulties of finding out truth amidst the various and contradictory opinions, interests, and passions of mankind, are many; and the wants of the creature, and of those with whom he is connected, numerous and urgent: so that it may be said of most men, that their *intellectual* organs are as much shut up and secluded from proper nourishment and exercise in that little circle to which they are confined, as the bodily organs are in the womb. Nay, those who to an aspiring genius have added all the assistances of art, leisure, and the most liberal education, what narrow prospects can even they take of this unbounded scene of things from that little eminence on which they stand? and how eagerly do they still grasp at new discoveries, without any satisfaction or limit to their ambition?

234 Intellectual.

235 Moral powers.

But should it be said, that man is made for *action*, and not for *speculation*, or fruitless searches after knowledge, we ask, For what kind of action? Is it only for bodily exercises, or for *moral*, *political*, and *religious* ones? Of all these he is capable; yet, by the unavoidable circumstances of his lot, he is tied down to the *former*, and has hardly any leisure to think of the *latter*, or, if he has, wants the proper instruments of exerting them. The *love of virtue*, *of one's friends* and *country*, the *generous sympathy with mankind*, and *heroic zeal of doing good*, which are all so *natural* to great and good

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good minds, and some traces of which are found in the lowest, are seldom united with proportioned means or opportunities of exercising them: so that the *moral* spring, the noble energies and impulses of the mind, can hardly find proper scope even in the most fortunate condition; but are much depressed in some, and almost entirely restrained in the generality, by the numerous clogs of an indigent, sickly, or embarrassed life. Were such mighty powers, such godlike affections, planted in the human breast to be folded up in the narrow womb of our present existence, never to be produced into a more *perfect* life, nor to expatiate in the ample career immortality?

236 Unsatisfied desires of existence and happiness.

Let it be considered, at the same time, that no possession, no enjoyment, within the round of mortal things, is commensurate to the desires, or adequate to the capacities of the mind. The most exalted condition has its abatements; the happiest conjuncture of fortune leaves many wishes behind; and after the highest gratifications, the mind is carried forward in pursuit of new ones without end. Add to all, the fond *desire* of *immortality*, the secret *dread* of *non-existence*, and the high unremitting *pulse* of the soul beating for *perfection*, joined to the improbability or the impossibility of attaining it *here;* and then judge whether this elaborate structure, this magnificent apparatus of inward powers and organs, does not plainly point out an *hereafter*, *and intimate eternity to man?* Does nature give the finishing touches to the lesser and ignoble instances of her skill, and raise every other creature to the maturity and perfection of his being; and shall she leave her principal workmanship unfinished? Does she carry the *vegetative* and *animal* life in *man* to their full vigour and highest destination; and shall she suffer his *intellectual*, his *moral*, his *divine* life, to fade away, and be for ever extinguished? Would such abortions in the *moral* world be congruous to that *perfection of wisdom and goodness* which upholds and adorns the *natural?*

237 Therefore man immortal.

We must therefore conclude from this detail, that the *present state*, even at its best, is only the WOMB of man's being, in which the noblest principles of his nature are in a manner fettered, or secluded from a correspondent sphere of action; and therefore destined for a future and unbounded state, where they shall emancipate themselves, and exert the fulness of their strength. The most accomplished mortal, in this low and dark apartment of nature, is only the *rudiments* of what he shall be when he takes his ethereal flight, and puts on immortality. Without a reference to that state, *man* were a mere abortion, a rude unfinished embryo, a monster in nature. But this being once supposed, he still maintains his rank of the masterpiece of the creation; his latent powers are all suitable to the *harmony* and *progression* of nature; his noble aspirations, and the pains of his dissolution, are his efforts towards a *second* birth, the pangs of his delivery into light, liberty, and perfection; and *death*, his discharge from gaol, his separation from his fellow prisoners, and introduction into the assembly of those heroic spirits who are gone before him, and of their great eternal Parent. The fetters of his mortal coil being loosened, and his prison walls broke down, he will be bare and open on every side to the admission of *truth* and *virtue*, and their fair attendant *happiness;* every *vital* and *intellectual* spring will evolve itself with a divine elasticity in the free air of heaven. He will not then peep at the universe and its glorious Author through a dark grate or a gross medium, nor receive the reflections of his glory through the strait openings of sensible organs: but will be *all eye*, *all ear*, *all ethereal and divine feeling* *.

From the Immortality of the Soul.

Let one part, however, of the analogy be attended to: That as in the womb we receive our original constitution, form, and the essential *stamina* of our being, which we carry along with us into the light, and which greatly affect the succeeding periods of our life; so our temper and condition in the *future* life will depend on the conduct we have observed, and the character we have formed, in the *present* life. We are *here* in *miniature* what we shall be at *full length hereafter*. The first *rude sketch* or *outlines* of *reason* and *virtue* must be drawn at present, to be afterwards enlarged to the *stature* and *beauty* of angels.

* *Vide* Religion of Nature, § 9.

238 Immortality a guard and incentive to virtue.

This, if duly attended to, must prove not only a *guard*, but an admirable *incentive* to virtue. For he who faithfully and ardently follows the light of knowledge, and pants after higher improvements in virtue, will be wonderfully animated and inflamed in that pursuit by a full conviction that the scene does not close with life—that his struggles, arising from the weakness of nature and the strength of habit, will be turned into triumphs—that his career in the track of wisdom and goodness will be both swifter and smoother—and those generous ardours with which he glows towards *heaven*, i. e. the *perfection* and *immortality of virtue*, will find their adequate object and exercise in a sphere proportionably enlarged, incorruptible, immortal. On the other hand, what an inexpressible damn must it be to the good man, to dread the total extinction of that *light* and *virtue*, without which *life*, nay, *immortality* itself, were not worth a single wish?

239 Proof from the inequality of present distributions.

Many writers draw their proofs of the immortality of the soul, and of a future state of rewards and punishments, from the unequal distribution of these here. It cannot be dissembled that wicked men often escape the *outward* punishment due to their crimes, and do not feel the *inward* in that measure their demerit seems to require, partly from the callousness induced upon their nature by the habits of vice, and partly from the dissipation of their minds abroad by pleasure or business—and sometimes good men do not reap all the natural and genuine fruits of their virtue, through the many unforeseen or unavoidable calamities in which they are involved. To the smallest reflection, however, it is obvious that the natural tendency of virtue is to produce happiness; that if it were universally practised, it would, in fact, produce the greatest sum of happiness of which human nature is capable; and that this tendency is defeated only by numerous individuals, who, forsaking the laws of virtue, injure and oppress those who steadily adhere to them. But the natural tendency of virtue is the result of that constitution of things which was established by God at the creation of the world. This being the case, we must either conclude, that there will be a future state, in which all the moral obliquities of the present shall be made straight; or else admit, that the designs of infinite wisdom, goodness, and power, can be finally defeated by the perverse conduct of human weakness.—But this last supposition is so extravagantly absurd,

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that the reality of a future state, the only other possible alternative, may be pronounced to have the evidence of perfect demonstration.

240 Belief of immortality, &c. a great support amidst trials.

Virtue has present rewards, and *vice* present punishments annexed to it; such rewards and punishments as make *virtue*, in most cases that happen, far more eligible than *vice*: but, in the infinite variety of human contingencies, it may sometimes fall out, that the inflexible practice of virtue shall deprive a man of considerable advantages to himself, his family, or friends, which he might gain by a well-timed piece of roguery; suppose by betraying his trust, voting against his conscience, selling his country, or any other crime where the security against discovery shall heighten the temptation. Or, it may happen, that a strict adherence to his honour, to his religion, to the cause of liberty and virtue, shall expose him, or his family, to the loss of every thing, nay, to poverty, slavery, death itself, or to torments far more intolerable. Now what shall secure a man's virtue in circumstances of such trial? What shall enforce the obligations of conscience against the allurements of so many interests, the dread of so many and so terrible evils, and the almost unsurmountable aversion of human nature to excessive pain! The conflict is the greater, when the circumstances of the crime are such as easily admit a variety of alleviations from *necessity*, *natural affection*, *love to one's family* or *friends*, perhaps in indigence: these will give it even the air of virtue. Add to all, that the crime may be thought to have few bad consequences,—may be easily concealed,—or imagined possible to be retrieved in a good measure by future good conduct. It is obvious to which side most men will lean in such a case; and how much need there is of a balance in the opposite scale, from the consideration of a *God*, of a *Providence*, and of an *immortal state of retribution*, to keep the mind firm and uncorrupted in those or like instances of singular trial or distress.

241 In the general course of life.

But without supposing such peculiar instances, a sense of a governing Mind, and a persuasion that virtue is not only befriended by him here, but will be crowned by him hereafter with rewards suitable to its nature, vast in themselves, and immortal in their duration, must be not only a mighty support and incentive to the practice of virtue, but a strong barrier against vice. The thoughts of an Almighty Judge, and of an impartial future reckoning, are often alarming, inexpressibly so, even to the stoutest offenders. On the other hand, how supporting must it be to the good man, to think that he acts under the eye of his friend, as well as judge! How improving, to consider the *present state* as connected with a *future* one, and every relation in which he stands as a *school* of *discipline* for his *affections*; every *trial* as the *exercise* of some *virtue*; and the virtuous deeds which result from both, as introductory to higher scenes of *action* and *enjoyment!* Finally, How transporting is it to view *death* as his *discharge* from the *warfare* of *mortality*, and a triumphant *entry* into a state of freedom, security, and perfection, in which knowledge and wisdom shall break upon him from every quarter; where each faculty shall have its proper object: and his virtue, which was often damped or defeated here, shall be enthroned in undisturbed and eternal empire?

From the Immortality of the Soul.

242 Advantages of the Christian scheme, and its connexion with natural religion or morality.

On reviewing this short *system* of *morals*, and the *motives* which support and enforce it, and comparing both with the CHRISTIAN *scheme*, what *light* and *vigour* do they borrow from thence! How clearly and fully do CHRISTIANITY lay open the *connexions* of our nature, both *material* and *immaterial*, and *future* as well as *present!* what an ample and beautiful detail does it present of the *duties* we owe to *God*, to *society*, and *ourselves*, promulgated in the most simple, intelligible, and popular manner; divested of every partiality of sect or nation; and adapted to the general state of mankind! With what bright and alluring *example* does it illustrate and recommend the practice of those duties: and with what mighty *sanctions* does it enforce that practice! How strongly does it describe the *corruptions* of our nature; the *deviations* of our life from the *rule* of *duty*, and the *causes* of both! How marvellous and benevolent a plan of *redemption* does it unfold, by which those corruptions may be remedied, and our *nature* restored from its *deviations* to transcendent heights of *virtue* and *piety!* Finally, What a fair and comprehensive prospect does it give us of the *administration* of *God*, of which it represents the *present state* only as a *small period*, and a *period* of *warfare* and *trial!* How solemn and unbounded are the scenes which it opens beyond it! the *resurrection* of the *dead*, the *general judgment*, the *equal distribution* of *rewards* and *punishments* to the *good* and the *bad*; and the full *completion* of *divine wisdom* and *goodness* in the *final establishment* of *order*, *perfection*, and *happiness!* How glorious then is that SCHEME of RELIGION, and how worthy of *affection* as well as of *admiration*, which, by making such *discoveries*, and affording such *assistances*, has disclosed the unfading fruits and triumphs of VIRTUE, and secured its interests beyond the power of TIME and CHANCE.

Moral ‖ Morass.

MORAL Sense, that whereby we perceive what is good, virtuous, and beautiful, in actions, manners, and characters. See *MORAL Philosophy*.

MORALITY. See *MORAL Philosophy*.

MORANT-Point, the most easterly point or promontory of the island of Jamaica, in America. W. Long. 75. 56. N. Lat. 17. 56.

MORASS, a marsh, fen, or low moist ground, which receives the waters from above without having any descent to carry them off again. Somner derives the word from the Saxon *mersc*, "lake;" Salmasius from *mare*, "a collection of waters;" others from the German *marast* "a muddy place; and others from *marese*, of *mariscetum*, *à mariscis*, i. e. rushes. See DRAINING, AGRICULTURE *Index*.

Morass, Morat.

In Scotland, Ireland, and the north of England, there is a particular kind of morasses called *mosses*, or *peat-mosses*, whence the country people dig their peat or turf for firing. See Moss.

MORAT, or MURTEN, a considerable town of Switzerland,

Morat, Morata.

Switzerland, capital of a bailiwick of the same name, belonging to the cantons of Bern and Friburg. It is seated on the lake Morat, on the road from Avenche to Bern, 10 miles west of Bern and 10 miles north-east of Friburg. The lake is about six miles long and two broad, and the country about it pleasant and well cultivated. The lakes of Morat and Neufchatel are parallel to each other, but the latter is more elevated, discharging itself by means of the river Broye into the lake of Neufchatel. According to M. de Luc, the former is 15 French feet above the level of Neufchatel lake; and both these lakes, as well as that of Bienne, seem formerly to have extended considerably beyond their present limits, and from the position of the country appear to have been once united. Formerly the large fish named *silurus glanis*, or the saluth, frequented these lakes, but has not been caught in them for a long time past. The environs of this town and lake were carefully examined by Mr Coxe, during his residence in Switzerland, who made several excursions across the lake to a ridge of hills situated betwixt it and Neufchatel. Here are many delightful prospects; particularly one from the top of Mount Vuilly, which, he says, is perhaps the only central spot from which the eye can at once comprehend the vast amphitheatre formed on one side by the Jura stretching from the environs of Geneva as far as Basle, and, on the other, by that stupendous chain of snowy Alps which extend from the frontiers of Italy to the confines of Germany, and is lost at each extremity in the horizon. Morat is celebrated for the obstinate defence it made against Charles the Bold, duke of Burgundy, and for the battle which afterwards followed on the 22d of June 1476, where the duke was defeated, and his army almost entirely destroyed *. Not far from the town, and adjoining to the high road, there still remains a monument of this victory. It is a square building, filled with the bones of Burgundian soldiers who were slain at the siege and in the battle; the number of which appears to have been very considerable. There are several inscriptions in the Latin and German languages commemorating the victory.

* See *History of France.*

MORATA, Olympia Fulvia, an Italian lady, distinguished for her learning, was born at Ferrara, in 1526. Her father, after teaching the belles lettres in several cities of Italy, was made preceptor to the two young princes of Ferrara, the sons of Alphonsus I. The uncommon abilities he discovered in his daughter determined him to give her all the advantages of education. Meanwhile the princess of Ferrara studying polite literature, it was judged expedient that she should have a companion in the same pursuit; and Morata being called, she was heard by the astonished courtiers to declaim in Latin, to speak Greek, and to explain the paradoxes of Cicero. Her father dying, she was obliged to return home to take upon her the management of family affairs, and the education of her brother and three sisters; both which she executed with the greatest diligence and success. In the mean time Andrew Grunthler, a young German physician, had married her, and with him she went to Germany, taking her brother along with her, whom she instructed in the Latin and Greek tongues; and after staying a short time at Augsburg, went to Schweinfort in Franconia, where her husband was born: but they had not been there long before that town was unhappily besieged and burnt; however, escaping the flames, they fled in the utmost distress to Hammelburg. This place they were also obliged to quit, and were reduced to the last extremities, when the elector Palatine invited Grunthler to be professor of physic at Heidelberg. He entered on his new office in 1554; but they no sooner began to taste the sweets of repose, than a disease, occasioned by the distresses and hardships they had suffered, seized upon Morata, who died in 1555, in the 29th year of her age; and her husband and brother did not long survive her. She composed several works, great part of which were burnt with the town of Schweinfort; the remainder, which consist of orations, dialogues, letters, and translations, were collected and published under the title of *Olympiæ Fulviæ Moratæ, fœminæ doctissimæ, et planè divinæ, opera omnia quæ hactenus inveniri potuerint; quibus Calii secundi curionis epistolæ ac orationes accesserunt.*

Morata, Moravia.

MORAVIA, a river of Turkey in Europe, which rises in Bulgaria, runs north through Servia by Nissa, and falls into the Danube at Semendria, to the eastward of Belgrade.

Moravia, a marquisate of Germany, derives the name of *Mahern*, as it is called by the Germans, and of *Morawa*, as it is called by the natives, from the river of that name, which rises in the mountains of the county of Glatz, and passes through the middle of it. It is bounded to the south by Austria, to the north by Silesia, to the west by Bohemia, and to the east by Silesia and Hungary; being about 120 miles in length and 100 in breadth. Its surface is about 89,000 square miles. In 1775 its population, according to official returns, was 1,134,674, of whom 23,382 were Jews; but in 1801 has been computed to be 1,400,000 (Mentelle et Malte Brun). Olmutz, formerly the chief town, contains 11,000 inhabitants; Brunn, now the seat of government, contains 14,000; and there are several other considerable towns.

A great part of this country is overrun with woods and mountains, where the air is very cold, but much wholesomer than in the low grounds, which are full of bogs and lakes. The mountains, in general, are barren; but the more champaign parts tolerably fertile, yielding corn, with plenty of hemp and flax, good saffron, and pasture. Nor is it altogether destitute of wine, red and white, fruits, and garden stuff. Moravia also abounds in horses, black cattle, sheep, and goats. In the woods and about the lakes there is plenty of wild fowl, game, venison, bees, honey, hares, foxes, wolves, beavers, &c. This country affords marble, alum, iron, sulphur, saltpetre, and vitriol, with mineral waters, and warm springs; but salt is imported. Its rivers, of which the March, Morawa, or Moran, are the chief, abound with trout, crayfish, barbels, eels, perch, and many other sorts of fish.

The language of the inhabitants is a dialect of the Sclavonic, differing little from the Bohemian; but the nobility and citizens speak German and French.

Moravia was anciently inhabited by the Quadi, who were driven out by the Sclavi. Its kings, who were once powerful and independent, afterwards became dependent on, and tributary to, the German emperors and kings. At last, in the year 908, the Moravian kingdom was parcelled out among the Germans, Poles,

Moravia
Morbus.

and Hungarians. In 1086, that part of it properly called *Moravia* was declared a marquisate by the German king Henry IV. and united with Bohemia, to whose dukes and kings it hath ever since been subject. The states of the country consist of the clergy, lords, knights, and burgesses; and the diets, when summoned by the regency, are held at Brunn. The marquisate is still governed by its own peculiar constitutions, under the *directorium in publicis et cameralibus*, and the supreme judicatory at Vienna. It is divided into six circles, each of which has its captain, and contributes to its sovereign about one-third of what is exacted of Bohemia. Towards the expences of the military establishment of the whole Austrian hereditary countries, its yearly quota is 1,856,490 florins. Seven regiments of foot, one of cuirassiers, and one of dragoons, are usually quatered in it.

Christianity was introduced into this country in the 9th century; and the inhabitants continued attached to the church of Rome till the 15th, when they espoused the doctrine of John Huss, and threw off Popery: but after the defeat of the elector Palatine, whom they had chosen king, as well as the Bohemians, the emperor Ferdinand II. re-established Popery; though there are still some Protestants in Moravia. The bishop of Olmutz, who stands immediately under the pope, is at the head of the ecclesiastics in this country. The supreme ecclesiastical jurisdiction, under the bishop, is vested in a consistory.

The commerce of this country is inconsiderable. Of what they have, Brunn enjoys the principal part. At Iglau and Trebitx are manufactures of cloth, paper, gunpowder, &c. There are also some iron works and glass houses in the country.

The inhabitants of Moravia in general are open-hearted, not easy to be provoked or pacified, obedient to their masters, and true to their promises; but credulous of old prophecies, and much addicted to drinking, though neither such sots or bigots as they are represented by some geographers. The boors, indeed, upon the river Hank, are said to be a thievish, unpolished, brutal race. The sciences now begin to lift up their heads a little among the Moravians, the university of Olmutz having been put on a better footing; and a riding academy, with a learned society, has been lately established there.

MORAVIAN BRETHREN. See HERNHUTTERS, and UNITAS *Fratrum*.

MORAW, or MORAVA, a large river of Germany, which has its source on the confines of Bohemia and Silesia. It traverses the whole of Moravia, waters Olmutz and Hradisch, and receiving the Taya from the confines of Lower Hungary and Upper Austria, separates these two countries as far as the Danube, into which it falls.

MORBID, among physicians, signifies "diseased or corrupt;" a term applied either to an unsound constitution, or to those parts or humours that are affected by a disease.

MORBUS COMITIALIS, a name given to the epilepsy; because if on any day when the people were assembled in *comitia* upon public business, any person suddenly seized with this disorder should fall down, the assembly was dissolved, and the business of the *comitia*, however important, was suspended. See COMITIA.

MORBUS Regius, the same with the JAUNDICE. See MEDICINE *Index*.

Morbus
More.

MORBUS, or *Disease*, in *Botany*. See VARIETAS.

MORDAUNT, CHARLES, earl of Peterborough, a celebrated commander both by sea and land, was the son of John Lord Mordaunt Viscount Avalon, and was born about the year 1658. In 1675 he succeeded his father in his honours and estate. While young he served under the admirals Torrington and Narborough in the Mediterranean against the Algerines; and in 1680 embarked for Africa with the earl of Plymouth, and distinguished himself at Tangier when it was besieged by the Moors. In the reign of James II. he voted against the repeal of the test act; and disliking the measures of the court, obtained leave to go to Holland to accept the command of a Dutch squadron in the West Indies. He afterwards accompanied the prince of Orange into this kingdom; and upon his advancement to the throne, was sworn of the privy-council, made one of the lords of the bedchamber to his majesty, also first commissioner of the treasury, and advanced to the dignity of earl of Monmouth. But in November 1690 he was dismissed from his post in the treasury. On the death of his uncle Henry earl of Peterborough in 1697, he succeeded to that title; and, upon the accession of Queen Anne, was invested with the commission of captain-general and governor of Jamaica. In 1705 he was sworn of the privy-council; and the same year declared general and commander in chief of the forces sent to Spain, and joint admiral of the fleet with Sir Cloudesley Shovel, of which the year following he had the sole command. His taking Barcelona with a handful of men, and afterwards relieving it when greatly distressed by the enemy; his driving out of Spain the duke of Anjou, and the French army, which consisted of 25,000 men, though his own troops never amounted to 10,000; his gaining possession of Catalonia, of the kingdoms of Valencia, Arragon, and the isle of Majorca, with part of Murcia and Castile, and thereby giving the earl of Galway an opportunity of advancing to Madrid without a blow; are astonishing instances of his bravery and conduct. For these important services his lordship was declared general in Spain by Charles III. afterwards emperor of Germany; and on his return to England he received the thanks of the house of lords. His lordship was afterwards employed in several embassies to foreign courts, installed knight of the Garter, and made governor of Minorca. In the reign of George I. he was general of all the marine forces in Great Britain, in which post he was continued by King George II. He died in his passage to Lisbon, where he was going for the recovery of his health, in 1735. His lordship was distinguished by various shining qualities: for, to the greatest personal courage and resolution, he added all the arts and address of a general; a lively and penetrating genius; and a great extent of knowledge upon almost every subject of importance within the compass of ancient and modern literature.

MORDELLA, a genus of insects of the coleoptera order. See ENTOMOLOGY *Index*.

MORE, SIR THOMAS, lord high chancellor of England, the son of Sir John More, knight, one of the judges of the King's Bench, was born in the year 1480, in

More. in Milk-street London. He was first sent to a school at St Anthony's in Threadneedle street; and afterward introduced into the family of Cardinal Moreton, who in 1497 sent him to Canterbury college in Oxford. During his residence at the university he constantly attended the lectures of Linacre and Grocinus, on the Greek and Latin languages. Having in the space of about two years made considerable proficiency in academical learning, he came to New Inn in London, in order to study the law; whence, after some time, he removed to Lincoln's Inn, of which his father was a member. Notwithstanding his application to the law, however, being now about 20 years old, he was so bigotted to monkish discipline, that he wore a hair shirt next his skin, frequently fasted, and often slept on a bare plank. In the year 1503, being then a burgess in parliament, he distinguished himself in the house, in opposition to the motion for granting a subsidy and three fifteenths for the marriage of Henry VII.'s eldest daughter, Margaret, to the king of Scotland. The motion was rejected; and the king was so highly offended at this opposition from a beardless boy, that he revenged himself on Mr More's father, by sending him, on a frivolous pretence, to the Tower, and obliging him to pay 100l. for his liberty. Being now called to the bar, he was appointed law reader at Furnival's inn, which place he held about three years; but about this time he also read a public lecture in the church of St Lawrence, Old Jewry, upon St Austin's treatise *De Civitate Dei*, with great applause. He had indeed formed a design of becoming a Franciscan friar, but was dissuaded from it; and, by the advice of Dr Colet, married Jane, the eldest daughter of John Colt, Esq. of Newhall in Essex. In 1508 he was appointed judge of the sheriff's court in the city of London, was made a justice of the peace, and became very eminent at the bar. In 1516 he went to Flanders in the retinue of Bishop Tonstal and Dr Knight, who were sent by King Henry VIII. to renew the alliance with the archduke of Austria, afterwards Charles V. On his return, Cardinal Wolsey would have engaged Mr More in the service of the crown, and offered him a pension, which he refused. Nevertheless, it was not long before he accepted the place of master of the requests, was created a knight, admitted of the privy council, and in 1520 made treasurer of the exchequer. About this time he built a house on the bank of the Thames, at Chelsea, and married a second wife. This wife, whose name was *Middleton*, and a widow, was old, ill tempered, and covetous; nevertheless Erasmus says, he was as fond of her as if she were a young maid.

In the 14th year of Henry VIII. Sir Thomas More was made speaker of the house of commons; in which capacity he had the resolution to oppose the then powerful minister, Wolsey, in his demand of an oppressive subsidy; notwithstanding which, it was not long before he was made chancellor of the duchy of Lancaster, and was treated by the king with singular familiarity. The king having once dined with Sir Thomas at Chelsea, walked with him near an hour in the garden, with his arm round his neck. After he was gone, Mr Roper, Sir Thomas's son-in-law, observed how happy he was to be so familiarly treated by the king: to which Sir Thomas replied, "I thank our lord, son Roper, I find his grace my very good lord indeed, and believe he doth as singularly favour me as any subject within this realm: howbeit, I must tell thee, I have no cause to be proud thereof; for if my head would win him a castle in France, it would not fail to go off." From this anecdote it appears, that Sir Thomas knew his grace to be a villain. More.

In 1526 he was sent with Cardinal Wolsey and others, on a joint embassy to France, and in 1529 with Bishop Tonstal to Cambray. The king, it seems, was so well satisfied with his services on these occasions, that in the following year, Wolsey being disgraced, he made him chancellor; which seems the more extraordinary, when we are told that Sir Thomas had repeatedly declared his disapprobation of the king's divorce, on which the great *defensor fidei* was so positively bent. Having executed the office of chancellor about three years, with equal wisdom and integrity, he resigned the seals in 1533, probably to avoid the danger of his refusing to confirm the king's divorce. He now retired to his house at Chelsea; dismissed many of his servants; sent his children with their respective families to their own houses (for hitherto, he had, it seems, maintained all his children, with their families, in his own house, in the true style of an ancient patriarch; and spent his time in study and devotion: but the capricious tyrant would not suffer him to enjoy his tranquillity. Though now reduced to a private station, and even to indigence, his opinion of the legality of the king's marriage with Anne Boleyn was deemed of so much importance, that various means were tried to procure his approbation; but all persuasion proving ineffectual, he was, with some others, attainted in the house of lords of misprision of treason, for encouraging Elizabeth Barton, the nun of Kent, in her treasonable practices. His innocence in this affair appeared so clearly, that they were obliged to strike his name out of the bill. He was then accused of other crimes, but with the same effect; till, refusing to take the oath enjoined by the act of supremacy, he was committed to the Tower, and, after 15 months imprisonment, was tried at the bar of the king's bench for high treason, in denying the king's supremacy. The proof rested on the sole evidence of Rich the solicitor general, whom Sir Thomas, in his defence, sufficiently discredited; nevertheless the jury brought him in guilty, and he was condemned to suffer as a traitor. The merciful Harry, however, indulged him with simple decollation; and he was accordingly beheaded on Tower hill, on the 5th of July 1535. His body, which was first interred in the Tower, was begged by his daughter Margaret, and deposited in the chancel of the church at Chelsea, where a monument, with an inscription written by himself, had been some time before erected. This monument with the inscription is still to be seen in that church. The same daughter, Margaret, also procured his head after it had remained 14 days upon London bridge, and placed it in a vault belonging to the Roper family, under a chapel adjoining to St Dunstan's church in Canterbury. Sir Thomas More was a man of some learning, and an upright judge; a very priest in religion, yet cheerful, and even affectedly witty More.

More, Morel.

witty (A). He wanted not sagacity, where religion was out of the question; but in that his faculties were so enveloped, as to render him a weak and credulous enthusiast. He left one son and three daughters; of whom Margaret, the eldest, was very remarkable for her knowledge of the Greek and Latin languages. She married a Mr Roper of Wellhall in Kent, whose life of Sir Thomas More was published by Mr Hearne at Oxford in 1716. Mrs Roper died in 1544; and was buried in the vault of St Dunstan's in Canterbury, with her father's head in her arms.

Sir Thomas was the author of various works, though his *Utopia* is the only performance that has survived in the esteem of the world; owing to the rest being chiefly of a polemic nature: his answer to Luther has only gained him the credit of having the best knack of any man in Europe, at calling bad names in good Latin. His English works were collected and published by order of Queen Mary, in 1557; his Latin, at Basil, in 1563, and at Louvain, in 1566,

MOREA, formerly called the *Peloponnesus*, is a peninsula to the south of Greece, to which it is joined by the isthmus of Corinth. Its form resembles a mulberry leaf, and its name is derived from the great number of mulberry trees which it produces. It is about 140 miles in length, and 110 in breadth. The air is temperate, and the land fertile, except in the middle, where it is full of mountains, and is watered by a great number of rivers. It is divided into three provinces; Scania, Belvedera, and Brazzo-di-Maina. It was taken from the Turks by the Venetians in 1687; but they lost it again in 1715. The population of the Morea is estimated by Dr Clarke at 300,000. See GREECE and PELOPONNESUS.

MOREL, the name of several celebrated printers to the kings of France, who, like the Stephens, were also men of great learning.

Frederic MOREL, who was interpreter in the Greek and Latin tongues, as well as printer to the king, was heir to Vascosan, whose daughter he had married.—He was born in Champagne, and he died in an advanced age at Paris, 1583. His sons and grandsons trode in his steps; they distinguished themselves in literature, and maintained also the reputation which he had acquired by printing. The edition of *St Gregory of Nyssa*, by his son Claude Morel, is held in great estimation by the learned.

MOREL, *Frederic*, son of the preceding, and still more celebrated than his father, was professor and interpreter to the king, and printer in ordinary for the Hebrew, Greek, Latin, and French languages. He was so devoted to study, that when he was told his wife was at the point of death, he would not stir till he had finished the sentence which he had begun. Before it was finished, he was informed that she was actually dead; *I am sorry for it*, (replied he coldly), *she was an excellent woman*. This printer acquired great reputation from the works which he published, which were very numerous and beautifully executed. From the manuscripts in the king's library, he published several treatises of St Basil, Theodoret, St Cyrille; and he accompanied them with a translation. His edition of the works of Œcumenius and Aretas, in 2 vols. folio, is much esteemed. In short, after distinguishing himself by his knowledge in the languages, he died June 27. 1630, at the age of 78. His sons and grandsons followed the same profession.

Morel || Morgagni

MOREL, *William*, regius professor of Greek, and director of the king's printing house at Paris, died 1564. He composed a *Dictionnaire Grec-Latin Francois*, which was published in quarto in 1622, and some other works which indicate very extensive learning. His editions of the Greek authors are exceedingly beautiful. This great scholar, who was of a different family from the preceding, had a brother named John, who died in prison (where he had been confined for heresy) at the age of 20, and whose body was dug out of the grave, and burnt, Feb. 27. 1559. They were of the parish of Tilleul, in the county of Mortein in Normandy.

MORENA, in *Ancient Geography*, a district or division of Mysia, in the Hither Asia. A part of which was occupied by Cleon, formerly at the head of a band of robbers, but afterwards priest of Jupiter Abrettenus, and enriched with possessions, first by Antony, and then by Cæsar.

MORESQUE, MORESK, or *Morisko*, a kind of painting, carving, &c. done after the manner of the Moors; consisting of several grotesque pieces and compartments promiscuously intermingled, not containing any perfect figure of a man, or other animal, but a wild resemblance of birds, beasts, trees, &c. These are also called *arabesques*, and are particularly used in embroideries, damask work, &c.

MORESQUE Dances, vulgarly called *Morrice dances*, are those altogether in imitation of the Moors, as sarabands, chacons, &c. and are usually performed with castanets, tambours, &c.

There are few country places in England where the morrice dance is not known. It was probably introduced about, or a little before, the reign of Henry VIII. and is a dance of young men in their shirts, with bells at their feet, and ribbands of various colours tied round their arms and flung across their shoulders.

MORGAGNA. See FATA.

MORGAGNI, JOHN BAPTIST, doctor of medicine, first professor of anatomy in the university of Padua, and member of several of the most eminent societies of learned men in Europe, was born in the year 1682, at Forli, a town in the district of *La Romagna* in Italy. His

(A) This last disposition, we are told, he could not restrain even at his execution. The day being come, he ascended the scaffold, which seemed so weak that it was ready to fall; whereupon, "I pray (said he) see me safe up, and for my coming down let me shift for myself." His prayers being ended, he turned to the executioner, and with a cheerful countenance said, "Pluck up thy spirits, man, and be not afraid to do thy office; my neck is very short, take heed therefore thou strike not awry for saving thy honesty." Then laying his head upon the block, he bade him stay until he had put aside his beard, saying, "That had never committed any treason."

Morgagni. His parents, who were in easy circumstances, allowed him to follow that course in life his genius dictated. He began his studies at the place of his nativity; but soon after removed to Bologna, where he obtained the degree of Doctor of Medicine, when he had but just reached the 16th year of his age. Here his peculiar taste for anatomy found an able preceptor in Valsalva, who bestowed on him the utmost attention; and such was the progress he made under this excellent master, that at the age of 20 he himself taught anatomy with high reputation. Soon, however, the fame of his prelections, and the number of his pupils, excited the jealousy of the public professors, and gave rise to invidious persecutions. But his abilities and prudence gained him a complete triumph over his enemies; and all opposition to him was finally terminated from his being appointed by the senate of Bologna to fill a medical chair, which soon became vacant. But the duties of this office, although important, neither occupied the whole of his time, nor satisfied his anxious desire to afford instruction. He still continued to labour in secret on his favourite subject, and soon after communicated the fruits of these labours to the public in his *Adversaria Anatomica*, the first of which was published in the year 1706, the second and third in 1717, and the three others in 1719. The publication of this excellent work spread the fame of Morgagni far beyond the limits of the state of Bologna. Such was his reputation, that the wise republic of Venice had no hesitation in making him an offer of the second chair of the theory of medicine in the university of Padua; then vacant by the death of M. Molinetti; and, to ensure his acceptance, they doubled the emoluments of that appointment. While he was in this department, he published his treatise, entitled *Nova Institutionum medicarum idea*, which first appeared at Padua in the year 1712. From this work his former reputation suffered no diminution. And soon after he rose, by different steps, to be first professor of anatomy in that celebrated university. Although Morgagni was thus finally settled at Padua, yet he gave evident proofs of his gratitude and attachment to Bologna, which he considered as his native country with respect to the sciences. He exerted his utmost efforts in establishing the academy of Bologna, of which he was one of the first associates; and he enriched their publications with several valuable and curious papers. Soon after this, the Royal Societies of London and Paris received him among their number. Not long after the publication of his *Adversaria Anatomica*, he began, much upon the same plan, his *Epistolæ Anatomicæ*, the first of which is dated at Padua in the beginning of April 1726. The works of Morgagni which have already been mentioned, are to be considered, in a great measure, as strictly anatomical: but he was not more eminent as an anatomist, than as a learned and successful physician. In the year 1760, when he was not far distant from the 80th year of his age, he published his large and valuable work *De causis et sedibus morborum per anatomen indagatis*. This last and most important of all his productions will afford convincing evidence of his industry and abilities to latest posterity. Besides these works, he published, at different periods of his life, several miscellaneous pieces, which were afterwards collected into one volume, and printed under his own eye at Padua, in the year 1765. It does not appear that he had in view any future publications; but he intended to have favoured the world with a complete edition of all his works, which would probably have been augmented with many new observations. In this he was engaged when, on the 5th of December 1771, after he had nearly arrived at the 90th year of his age, death put a period to his long and glorious career in the learned world. Morgagni || Morison.

MORGANA, or MORGAGNA, *Fata*. See FATA.

MORGES, a town of Swisserland in the canton of Berne, a place of some trade, and situated on the lake of Geneva, five miles from Lausanne. E. Long. 6. 42. N. Lat. 46. 29.

MORGO, anciently *Amorgos*, an island in the Archipelago, which produces wine, oil, and corn. It is well cultivated, and the inhabitants are affable, and generally of the Greek church. The best parts belong to a monastery. The greatest inconvenience in this island is the want of wood. It is 30 miles in circumference. E. Long. 26. 15. N. Lat. 36. 30.

MORIAH, one of the eminences of Jerusalem; on which Abraham went to offer his son, and David wanted to build the temple, which was afterwards executed by Solomon: The threshing floor of Araunah; originally narrow, so as scarce to contain the temple, but enlarged by means of ramparts; and surrounded with a triple wall, so as to add great strength to the temple, (Josephus). It may be considered as a part of Mount Sion, to which it was joined by a bridge and gallery, (*Id.*).

MORILLES, a kind of mushroom, about the size of a walnut, pierced with holes like a honey-comb, and said to be good for creating an appetite. It is often used in sauces and ragouts.

MORINA, a genus of plants belonging to the diandria class; and in the natural method ranking under the 48th order, *Aggregatæ*. See BOTANY *Index*.

MORINORUM CASTELLUM, in *Ancient Geography*, simply Castellum (Antonine); situated on an eminence, with a spring of water on its top, in the territory of the Morini. Now *Mont Cassel*, in Flanders.

MORINDA, a genus of plants belonging to the pentandria class, and in the natural method ranking under the 48th order, *Aggregatæ*. See BOTANY *Index*.

MORISON, ROBERT, physician and professor of botany at Oxford, was born at Aberdeen in 1620, bred at the university there, and taught philosophy for some time in it; but having a strong inclination to botany, made great progress in that science. The civil wars obliged him to leave his country; which, however, he did not do till he had first signalized his zeal for the interest of the king, and his courage, in a battle fought between the inhabitants of Aberdeen and the Presbyterian troops on the bridge of Aberdeen, in which he received a dangerous wound on the head. As soon as he was cured of it, he went into France; and fixing at Paris, he applied assiduously to botany and anatomy. He was introduced to the duke of Orleans, who gave him the direction of the royal gardens at Blois. He exercised the office till the death of that prince, and afterwards went over to England in 1660. Charles II. to whom the duke of Orleans had presented him at Blois, sent for him to London, and gave him the title

of

Morison || Morlachia.

of his *physician*, and that of *professor royal of botany*, with a pension of 200l per annum. The *Præludium Botanicum*, which he published in 1669, procured him so much reputation, that the university of Oxford invited him to the professorship of botany in 1669; which he accepted, and acquitted himself in it with great ability. He died at London in 1683, aged 63. He published a second and third part of his History of Plants, in 2 vols. folio; with this title, *Plantarum Historia Oxoniensis Universalis*. The first part of this excellent work has not been printed; and it is not known what has become of it.

MORISONIA, a genus of plants belonging to the monadelphia class, and in the natural method ranking under the 25th order, *Putaminæ*. See BOTANY *Index*.

MORLACHIA, a mountainous country of Dalmatia. The inhabitants are called *Morlacks* or *Morlacchi*; they inhabit the pleasant valleys of Koter, along the rivers Kerka, Cettina, Narenta, and among the inland mountains of Dalmatia. The inhabitants are by some said to be of Walachian extraction, as is indicated by their name; Morlachia being a contraction of *Mauro Walachia*, that is, *Black Walachia*: and the Walachians are said to be descendants of the ancient Roman colonies planted in these countries. This, however, is denied by the Abbé Fortis, who published a volume of travels into that country. He informs us that the origin of the Morlacchi is involved in the darkness of barbarous ages, together with that of many other nations, resembling them so much in customs and language, that they may be taken for one people, dispersed in the vast tracts from the Adriatic sea to the Frozen ocean.

With regard to the etymology of the name, the Abbé observes, that the Morlacchi generally call themselves, in their own language, *Vlassi*; a national term, of which no vestige is found in the records of Dalmatia till the 13th century. It signifies *powerful men*, or *men of authority*; and the denomination of *Moro Vlassi*, corruptly *Morlacchi*, as they are now called, may perhaps point out the original of the nation. This word may possibly signify the *conquerors that came from the sea*; *moor*, in all the dialects of the Sclavonian language, signifying the *sea*.

With regard to the character of these people, we are informed that they are much injured by their maritime neighbours. The inhabitants of the sea coast of Dalmatia tell many frightful stories of their avarice and cruelty: but these, in our author's opinion, are all either of an ancient date, or if any have happened in latter times, they ought rather to be ascribed to the corruption of a few individuals, than to the bad disposition of the nation in general; and though thievish tricks are frequent among them, he informs us, that a stranger may travel securely through their country, where he is faithfully escorted, and hospitably treated.

As to the Morlacchi themselves, they are represented as open and sincere to such a degree, that they would be taken for simpletons in any other country; and by means of this quality they have been so often duped by the Italians, that *the faith of an Italian* and *the faith of a dog*, are synonymous among the Morlacchi. They are very hospitable to strangers; and their hospitality is equally conspicuous among the rich and poor. The rich prepares a roasted lamb or sheep, and the poor with equal cordiality offers whatever he has; nor is this generosity confined to strangers, but generally extends itself to all who are in want. When a Morlack is on a journey, and comes to lodge at a friend's house, the eldest daughter of the family, or the new married bride, if there happen to be one, receives and kisses him when he alights from his horse or at the door of the house: but a foreigner is rarely favoured with these female civilities; on the contrary the women, if they are young, hide themselves, and keep out of his way. Morlachia.

The Morlacchi in general have little notion of domestic economy, and readily consume in a week as much as would be sufficient for several months, whenever any occasion of merriment presents itself. A marriage, the holiday of the saint protector of the family, the arrival of relations or friends, or any other joyful incident, consumes of course all that there is to eat and to drink in the house. Yet the Morlack is a great economist in the use of his wearing apparel; for rather than spoil his new cap, he takes it off, let it rain ever so hard, and goes barcheaded in the storm. In the same manner he treats his shoes, if the road is dirty and they are not very old. Nothing but an absolute impossibility hinders a Morlack from being punctual; and if he cannot repay the money he borrowed at the appointed time, he carries a small present to his creditor, and requests a longer term.

Friendship is lasting among the Morlacchi. They have even made it a kind of religious point, and tie the sacred bond at the foot of the altar. The Sclavonian ritual contains a particular benediction for the solemn union of two male or two female friends in the presence of the congregation. The male friends thus united are called *Pobratimi*, and the female *Posestreme*, which means half-brothers and half-sisters. From those consecrated friendships among the Morlacchi and other nations of the same origin, it should seem that the *sworn brothers* arose; a denomination frequent enough among the common people of Italy and in many parts of Europe. The difference between these and the Pobratimi of Morlachia consists not only in the want of the ritual ceremony, but in the design of the union itself. For, among the Morlacchi, the sole view is reciprocal service and advantage; but such a brotherhood among the Italians is generally commenced by bad men, to enable them the more to hurt and disturb society.

But as the friendships of the Morlacchi are strong and sacred, so their quarrels are commonly unextinguishable. They pass from father to son; and the mothers fail not to put their children in mind of their duty to revenge their father if he has had the misfortune to be killed, and to show them often the bloody shirt and arms of the dead. And so deeply is revenge rooted in the minds of this nation, that all the missionaries in the world would not be able to eradicate it. A Morlack is naturally inclined to do good to his fellow creatures, and is full of gratitude for the smallest benefit; but implacable if injured or insulted.

A Morlack who has killed another of a powerful family, is commonly obliged to save himself by flight, and

Morlacchi. and to keep out of the way for several years. If during that time he has been fortunate enough to escape the search of his pursuers, and has got a small sum of money, he endeavours to obtain pardon and peace; and, that he may treat about the conditions in person, he asks and obtains a safe conduct, which is faithfully maintained, though only verbally granted. Then he finds mediators: and, on the appointed day, the relations of the two hostile families are assembled, and the criminal is introduced, dragging himself along on his hands and feet, the musket, pistol, or cutlass, with which he committed the murder, hung about his neck; and while he continues in that humble posture, one or more of the relations recites a panegyric on the dead, which sometimes rekindles the flames of revenge, and puts the poor prostrate in no small danger.

The Morlacks, whether they happen to be of the Roman or of the Greek church, have very singular ideas about religion: and the ignorance of their teachers daily augments this monstrous evil. They are as firmly persuaded of the reality of witches, fairies, enchantments, nocturnal apparitions, and sortileges, as if they had seen a thousand examples of them. Nor do they make the least doubt about the existence of vampires: and attribute to them, as in Transylvania, the sucking the blood of infants. Therefore, when a man dies suspected of becoming a vampire, or *vukodlak*, as they call it, they cut his hams, and prick his whole body with pins; pretending, that after this operation he cannot walk about. There are even instances of Morlacchi, who, imagining that they may possibly thirst for children's blood after death, entreat their heirs, and sometimes oblige them to promise, to treat them as vampires when they die.

A most perfect discord reigns in Morlacchia, as it generally does in other parts, between the Latin and Greek communion, which their respective priests fail not to foment, and tell a thousand little scandalous stories of each other. The churches of the Latins are poor, but not very dirty; those of the Greeks are equally poor, and shamefully ill kept. Our author has seen the curate of a Morlack village sitting on the ground in the churchyard, to hear the confession of women on their knees by his side: a strange posture indeed! but a proof of the innocent manners of those good people, who have the most profound veneration for their spiritual pastors, and a total dependence upon them; who, on their part, frequently make use of a discipline rather military, and correct the bodies of their offending flock with the cudgel.

Innocence, and the natural liberty of pastoral ages, are still preserved among the Morlacchi, or at least many traces of them remain in the places farthest distant from our settlements. Pure cordiality of sentiment is not there restrained by other regards, and displays itself without any distinction of circumstances. A young handsome Morlack girl, who meets a man of her district on the road, kisses him affectionately, without the least imputation of impropriety; and M. Fortis has seen all the women and girls, all the young men and old, kissing one another as they came into the churchyard on a holiday; so that they looked as if they all belonged to one family. He often observed the same thing on the road, and at the fairs in the maritime towns, where the Morlacchi came to sell their commodities. Morlacchi.

The dress of the unmarried women is the most complex and whimsical, in respect to the ornaments of the head; for when married they are not allowed to wear any thing else but a handkerchief, either white or coloured tied about it. The girls use a scarlet cap, to which they commonly hang a veil falling down on the shoulders, as a mark of their virginity. The better sort adorn their caps with strings of silver coins, among which are frequently seen very ancient and valuable ones; they have moreover ear rings of very curious work, and small silver chains with the figures of half moons fastened to the ends of them. But the poor are forced to content themselves with plain caps; or if they have any ornaments, they consist only of small exotic shells, round glass beads, or bits of tin. The principal merit of these caps, which constitute the good taste as well as vanity of the Morlack young ladies, is to attract and fix the eyes of all who are near to them by the multitude of ornaments, and the noise they make on the least motion of their heads.

Both old and young women wear about their necks large strings of round glass beads, of various size and colour; and many rings of brass, tin, or silver, on their fingers. Their bracelets are of leather covered with wrought tin or silver; and they embroider their stomachers, or adorn them with beads or shells. But the use of stays is unknown, nor do they put whalebone or iron in the stomacher. A broad woollen girdle surrounds their petticoat, which is commonly decked with shells, and of blue colour, and therefore called *modrina*. Their gown as well as petticoat, is of a kind of serge; and both reach near to the ancle: the gown is bordered with scarlet, and called *sadak*. They use no modrina in summer, and only wear the sadak without sleeves over a linen petticoat or shift.—The girls always wear red stockings; and their shoes are like those of the men, called *opanke*. The sole is of undressed ox hide, and the upper part of sheep's skin thongs knotted, which they call *aputc;* and these they fasten above the ancles, something like the ancient cothurnus. The unmarried women, even of the richest families, are not permitted to wear any other sort of shoes; though after marriage, they may, if they will, lay aside the opanke, and use the Turkish slippers. The girls keep their hair tressed under their caps, but when married they let it fall dishevelled on the breast; sometimes they tie it under the chin; and always have medals, beads, or bored coins, in the Tartar or American mode twisted amongst it.

Nothing is more common among the Morlacchi than marriages concluded between the old people of the respective families, especially when the parties live at a great distance, and neither see nor know each other; and the ordinary motive of these alliances is the ambition of being related to a numerous and powerful family, famous for having produced valiant men. A denial in such cases is very rare; nor does the father of the maid inquire much into the circumstances of the family that asks her. Sometimes a daughter of the master is given in marriage to the servant or tenant, as was usual in patriarchal times; so little are the women regarded in this country. But on these occasions, the Morlacchi girls enjoy the privilege of refusal. For he

Morlacchi. who acts by proxy, having obtained his suit, is obliged to go and bring the bridegroom: and, if on seeing each other, the young people are reciprocally content, the marriage is concluded, but not otherwise. In some parts it is the custom for the bride to go to see the house and family of the proposed husband, before she gives a definitive answer; and if the place or persons are disagreeable to her, she is at liberty to annul the contract.

The bride is conducted to a church, veiled, and surrounded by the friends of the bridegroom, or *svati*, as they are called, on horseback; and the sacred ceremony is performed amidst the noise of muskets, pistols, barbaric shouts and acclamations, which continue till she return to her father's house or to that of her husband, if not far off. The first day's entertainment is sometimes made at the bride's house, but generally at the bridegroom's, whither the svati hasten immediately after the nuptial benediction; and at the same time three or four men run on foot to tell the good news; the first who gets to the house has a kind of a towel embroidered at the ends, as a premium. The domachin, or head of the house, comes out to meet his daughter-in-law; and a child is handed to her, before she alights, to caress it; and if there happen to be none in the house, the child is borrowed from one of the neighbours. When she alights, she kneels down, and kisses the threshold.—Then the mother-in-law, or in her place some other female relation, presents a corn sieve, full of different kinds of grain, nuts, almonds, and other small fruit, which the bride scatters upon the svati, by handfuls, behind her back. The bride does not sit at the great table the first day, but has one apart for herself, the two diveri, and the stacheo. The bridegroom sits at table with the svati; but in all that day, consecrated to the matrimonial union, he must neither unloosen nor cut any thing whatever. The knum carves his meat, and cuts his bread. It is the domachin's business to give the toasts; and the stari-svat is the first who pledges him. Generally the hukkara, a very large wooden cup, goes round, first to the saint protector of the family; next to the prosperity of the holy faith; and sometimes to a name the most sublime and venerable. The most extravagant abundance reigns at these feasts; and each of the svati contributes, by sending a share of provisions. The dinner begins with fruit and cheese; and the soup comes last, just contrary to our custom. All sorts of domestic fowls, kid, lamb, and sometimes venison, are heaped in prodigal quantities upon their tables.

These nuptial feasts, called *sdrave* by the ancient Huns, are by the Morlacchi called *sdravize*, from whence the Italian word *stravizzo* is undoubtedly derived. They continue three, six, eight, or more days, according to the ability or prodigal disposition of the family where they are held. The new married wife gets no inconsiderable profit in these days of joy: and it usually amounts to much more than all the portion she brings with her, which often consists of nothing but her own clothes and perhaps a cow; nay, it happens sometimes that the parents, instead of giving money with their daughter, get something from the bridegroom by way of price. The bride carries water every morning, to wash the hands of her guests as long as the feasting lasts; and each of them throws a small piece of money into the bason after performing that function, which is a very rare one among them, excepting on such occasions. Morlacchi, Mornay.

The Morlacchi pass their youth in the woods, attending their flocks and herds; and in that life of quiet and leisure they often become dexterous in carving with a simple knife: they make wooden cups, and whistles adorned with fanciful bas reliefs, which are not void of merit, and at least show the genius of the people.

MORNAY, PHILIPPE DE, seigneur du Plessis Marly, was born at Buhy or Bishuy in Upper Normandy in France, in 1549, and was educated at Paris. What was then thought a prodigy in a gentleman, he made a rapid progress in the belles lettres, in the learned languages, and in theology. He was at first destined for the church; but the principles of Calvinism, which he had imbibed from his mother, effectually excluded him from the ecclesiastical preferments to which he was entitled by his interest, abilities, and birth. After the horrible massacre of St Bartholomew, Philippe de Mornay made the tour of Italy, Germany, England, and the Low Countries; and he was equally improved and delighted by his travels. Mornay afterwards joined the king of Navarre, at that time leader of the Protestant party, and so well known since by the name of Henry IV. This prince sent Mornay, who employed his whole abilities, both as a soldier and a writer, in defence of the Protestant cause, to conduct a negociation with Elizabeth queen of England; and left him wholly to his own discretion in the management of that business. He was successful in almost every negociation, because he conducted it like an able politician, and not with a spirit of intrigue. He tenderly loved Henry IV. and spoke to him on all occasions as to a friend. When he was wounded at Aumale, he wrote to him in these words: "Sire, You have long enough acted the part of Alexander, it is now time you should act that of Cæsar. It is our duty to die for your majesty, &c. It is glorious for you, Sire, that I dare venture to tell you it is your duty to live for us." This faithful subject did every thing in his power to raise Henry to the throne. But when he deserted the Protestant faith, he reproached him in the bitterest manner, and retired from court. Henry still loved him; and was extremely affected with an insult which he received in 1597 from one Saint Phal, who beat him with a cudgel, and left him for dead. Mornay demanded justice from the king, who gave him the following answer, a proof as well of his spirit as of his goodness of heart. "Monsieur Duplessis, I am exceedingly offended at the insult you have received; and I sympathize with you both as your sovereign and your friend. In the former capacity, I shall do justice to you and to myself; and had I sustained only the character of your friend, there are few perhaps who would have drawn their sword or sacrificed their life more cheerfully in your cause. Be satisfied, then, that I will act the part of a king, a master, and a friend," &c. Mornay's knowledge, probity, and valour, made him the soul of the Protestant party, and procured him the contemptuous appellation of the *Pope of the Huguenots*. He defended their doctrines both by speech and writing. One of his books on the Iniquity of the Mass, having stirred up all the Catholic divines, he refused

to

Mornay || Moroc.

to make any reply to their censures and criticisms except in a public conference. This was accordingly appointed to be held A. D. 1600, at Fountainbleau, where the court then was. The two champions were, Du Perron bishop of Evreux, and Mornay. After a great many arguments and replies on both sides, the victory was adjudged to Du Perron. He had boasted that he would point out to the satisfaction of every one five hundred errors in his adversary's book, and he partly kept his word. The Calvinists did not fail to claim the victory on this occasion, and they still continue to do so. This conference, instead of putting an end to the differences, was productive of new quarrels among the controversialists, and of much profane wit among the libertines. A Huguenot minister, who was present at the conference, observed with great concern to a captain of the same party,—"The bishop of Evreux has already driven Mornay from several strong holds." "No matter (replied the soldier), provided he does not drive him from Saumur." This was an important place on the river Loire, of which Duplessis was governor. Hither he retired, his attention being constantly occupied in defending the Huguenots, and in making himself formidable to the Catholics. When Louis XIII. was making preparations against the Protestants, Duplessis wrote him a letter, dissuading him from such a measure. After employing the most plausible arguments, he concludes in the following manner: "To make war on the subject, is an indication of weakness in the government. Authority consists in the quiet submission of the people, and is established by the prudence and justice of the governor. Force of arms ought never to be employed except in repelling a foreign enemy. The late king would have sent the new ministers of state to learn the first elements of polities, who like unskilful surgeons would apply violent remedies to every disease, and advise a man to cut off an arm when his finger aches." These remonstrances produced no other effect than the loss of the government of Saumur, of which he was deprived by Louis XIII. in 1621. He died two years after, November 11. 1623, aged 74, in his barony *de la Foret-sur-Seure* in Poitou. The Protestant cause never had an abler supporter, or one who did it more credit by his virtues and abilities.

Censeur des courtisans, mais à la cour aimé;
Fier ennemi de Rome, et de Rome estimé.—HENRIADE.

The following is a list of his works: 1. *Un Traité de l'Eucharistie*, 1604, in folio. 2. *Un Traité de la verité de la Religion Chretienne*, 8vo. 3. A book entitled *La Mystere d'Iniquité*, 4to. 4. *Un discours sur le droit pretendu par ceux de la maison de Guise*, 8vo. 5. Curious and interesting *Memoirs* from the year 1572 to 1629, 4 vols. 4to. valuable. 6. *Letters;* which are written with great spirit and good sense. David des Liques has given us his life in quarto; a book more interesting for the matter than the manner.

MORNE-GAROU, a very remarkable volcanic mountain on the island of St Vincent's in the West Indies. It was visited by Mr James Anderson surgeon in the year 1764. See ST VINCENTS.

MOROC, or MAROC, a beautiful bird of Abyssinia, described by Mr Bruce, who thinks its name is derived from *mar*, "honey," though he says that he never heard it was further concerned in the honey than destroying bees. It seems to pursue those insects out of enmity or diversion as well as for food, leaving great numbers dead on the ground, besides those which it devours for food.

Moroc || Morocco.

The moroc resembles the cuckoo in size and shape, but differs in other respects. Its mouth is very wide, the opening reaching almost to its eyes; the inside of the mouth and throat yellow, the tongue sharp-pointed, and capable of being drawn almost half its length out of the mouth beyond the point of its beak, and is very flexible. The head and neck are brown, without any mixture of other colours: there are likewise a number of very small and scarcely visible hairs at the root of the beak.

This seems to be the bird mentioned by Sparman under the name of *cuculus indicator*, which (he says) has the singular property of discovering the nests of wild bees, and leading travellers by a certain cry to the place where the treasure is deposited. According to Sparman's account, it makes known these discoveries by the same cry to foxes as well as to the human species; but Jerome Lobo, who mentions the Abyssinian bird, takes no notice of the foxes, though he mentions its singing melodiously when it arrives at the place where the honey is deposited. Both these accounts are severely criticised by Mr Bruce, who says, that honey is so abundant on every hillock and every tree, that a bird possessing this faculty could be of no use to man or to any other animal in that country, and that having never heard of such a bird in Abyssinia, he considers the account of it as a fiction.

MORNING, the beginning of the day, or the time of the sun rising. The astronomers reckon morning, *mane*, from the time of midnight to that of mid-day. Thus an eclipse is said to begin at 11 o'clock in the morning, &c.

MORNING star, is the planet Venus, when a little to the westward of the sun; that is, when she rises a little before. In this situation she is called by the Greeks *Phosphorus;* by the Latins *Lucifer*, &c.

MOROCCO, an empire of Africa, comprehending a considerable part of the ancient Mauritania, is bounded on the west by the Atlantic ocean; on the east by the river Mulvya, which separates it from Algiers; on the north by the Mediterranean; and on the south by Mount Atlas, or rather by the river Sus, which divides it from the kingdom of Tafilet. Its greatest length is from the north-east to the south-west, amounting to above 590 miles; its breadth is not above 260 where broadest, and in the narrowest places it is not above half that breadth. 1 Situation and boundaries.

The ancient history of Morocco has been already given under the article MAURITANIA. It continued under the dominion of the Romans upwards of 400 years. On the decline of that empire it fell under the Goths, who held it till about the year 600, when the Goths were driven out by the Vandals, the Vandals by the Greeks, and they in their turn by the Saracens, who conquered not only this empire, but we may say the whole continent of Africa; at least their religion, one way or other, is to be found in all parts of it. The Saracen empire did not continue long united under one head, and many princes set up for themselves in Africa as well as elsewhere, through whose dissensions the Almoravides were at length 2 History

Morocco. raised to the sovereignty, as related under the article ALGIERS, N° 2. Yusef, or Joseph, the second monarch of that line, built the city of Morocco, conquered the kingdom of Fez, and the Moorish dominions in Spain; all which were lost by his grandson Abbu Halli, who was defeated and killed by the Spaniards. On this prince's death the crown passed to the Mohedians, or Almohedes, with whom it had not continued above three generations, when Mohammed the son of Al Mansur lost the famous battle of Sierra Morena, in which 200,000 Moors were slain, and in consequence of which Alphonso X. retook a great many of the Moorish conquests immediately after.

Mohammed died soon after this disgrace, and left several sons, between whom a civil war ensued, during which the viceroys of Fez, Tunis, and Tremesen, found means to establish themselves as independent princes. At length one of the princes of the royal blood of Tremesen having defeated the Almohedes, made himself master of the kingdoms of Morocco and Fez, and entailed them on his own family. In a short time, however, this family was expelled by the Merini, the Merini by the Oatazes, and these by the Sharifs of Hascen, who have kept the government ever since.

3 Government. Nothing can be conceived more unjust and despotic than the government of Morocco, and nothing more degenerate than the character of the people. The emperor is allowed to have not only an uncontrollable power over the lives and fortunes of his subjects, but in a great measure over their consciences, in as much as he is the only person who, as the successor of the prophet, has a right to interpret the Koran; and appoints all the judges under him, of whom those of Morocco and Fez are the chief, whose business it is to explain and dispense all matters relating to their religion; and who, being his creatures and dependents, dare not steer otherwise than as he directs. Whenever therefore the laws are enacted by him, and proclaimed by his governors in all the provinces, as is commonly done, that none may plead ignorance, they are everywhere received with an implicit and religious submission. On the other hand, the subjects are bred up with a notion, that those who die in the execution of his command are entitled to an immediate admittance into paradise, and those who have the honour to die by his hand to a still greater degree of happiness in it. After this we need not wonder at finding so much cruelty, oppression, and tyranny on the one side, and so much submission, passiveness and misery on the other.

4 Account of the black troops. This latter, however, extends no farther than the Moors: for as to the mountaineers, the subjection and tribute they pay to those tyrants was always involuntary; and as for the negroes, their zeal and attachment is owing merely to the great sway and power which they have gained in the government, on various accounts. They were first introduced, or rather their importation increased, by the policy of Muley Ishmael, a late emperor, at a period when there was a great decrease of population in the empire, occasioned in some degree by the enormous cruelties exercised by its former sovereigns, who have been known not unfrequently, through a slight disgust, to abandon a whole town or province to the sword. In the character of Muley Ishmael were found the most singular inconsistencies; for it is certain, that although a tyrant, yet in other respects, as if to repair the mischief which he committed, Morocco. he left nothing undone for the encouragement of population.—He introduced large colonies of negroes from Guinea; built towns for them, many of which are still remaining, assigned them portions of land, and encouraged their increase by every possible means. He soon initiated them in the Mahometan faith; and had his plan been followed, the country by this time would have been populous, and probably flourishing. As the negroes are of a more lively, active and enterprising disposition than the Moors, they might soon have been taught the arts of agriculture; and their singular ingenuity might have been directed to other useful purposes. It is true, Muley Ishmael, when he adopted this plan, had more objects in view than that of merely peopling his dominions. He saw plainly that his own subjects were of too capricious a disposition to form soldiers calculated for his tyrannical purposes. They had uniformly manifested an inclination to change their sovereigns, though more from the love of variety than to reform the government, or restrain the abuses of tyranny. Muley Ishmael had discernment enough to see, that by forming an army of slaves, whose sole dependence should rest upon their master, he could easily train them in such a manner as to act in the strictest conformity to his wishes. He soon learnt that the great object with the negroes was plenty of money and liberty of plunder; in these he liberally indulged them, and the plan fully answered his expectations. Though, however, Muley Ishmael had no great merit in introducing subjects for the purposes of tyranny, yet the good effects of this new colonization were very generally experienced. By intermarrying among themselves, and intermixing among the Moors (for the Moors will keep negro women as concubines, though they seldom marry them), a new race of people started up, who became as useful subjects as the native inhabitants, and brought the empire into a much more flourishing state than it had ever been in since their great revolution.

Sidi Mahomet, his grandson and successor, had different views, and was actuated by different motives. From his inordinate avarice, he ceased to act towards his black troops in the generous manner which had distinguished his predecessor Muley Ishmael; and they soon showed themselves discontented with his conduct. They offered to place his eldest son Muley Ali, on the throne; but this prince, not unmindful of the duty which he owed his father and sovereign, declined their offer. They next applied to Muley Yazid, who at first accepted of the assistance they tendered, but in a short time relinquished the plan. Sidi Mahomet, disgusted with this conduct of the negroes, determined to curb their growing power, by disbanding a considerable part of these troops, and banishing them to distant parts of the empire.

5 Despotism of the emperors. A most flagrant species of despotism, which renders the emperors more formidable to their subjects, is their making themselves their sole heirs, and, in virtue of that, seizing upon all their effects, and making only such provision for their families as they think proper; and often, on some frivolous pretence, leaving them destitute of any, according to the liking or dislike they bear to the deceased; so that, upon the whole, they are the only makers, judges, and interpreters, and in many instances likewise the executioners, of their own laws, which have

no

Morocco

no other limits than their own arbitrary will. The titles which the emperors of Morocco assume, are those of *Most glorious, mighty, and noble emperor of Afric; king of Fez and Morocco, Tafilet, Suz, Dorha, and all the Algarbe, and its territories in Afric; grand Sharif* (or, as others write it, *Xarif*, that is, successor, or vicegerent), *of the great Prophet Mohammed, &c.*

6 Administration of justice.

The judges or magistrates who act immediately under the emperor are either spiritual or temporal, or rather ecclesiastical and military. The mufti and the cadis are judges of all religious and civil affairs; and the bashaws, governors, alcaides, and other military officers, of those that concern the state or the army: all of them the most obsequious creatures and slaves of their prince, and no less the rapacious tyrants of his subjects, and from whom neither justice nor favour can be obtained but by mere dint of money and extortionate bribery, from the highest to the lowest. Neither can it indeed be otherwise in such an arbitrary government, where the highest posts must not only be bought of the prince at a most extravagant price, and kept only by as exorbitant a tribute, which is yearly paid to him, but where no one is sure to continue longer than he can bribe some of the courtiers to insinuate to the monarch that he pays to the utmost of his power and much beyond what was expected from him. There are instances of the sultan elevating at once a common soldier to the rank of a bashaw, or making him a confidential friend; the following day he would perhaps imprison him, or reduce him again to the station of private soldier. Yet such is the disposition of these people, that they have an unbounded thirst for rank and power with all their uncertainties; and what is more extraordinary, when they have obtained a high station, they seldom fail to afford their sovereign a plea for ill treating them, by abusing in some way or other their trust.

7 Royal revenues.

From what has been said, it may be reasonably concluded that the revenue arising to the emperor from the last mentioned source, that of bribery, extortion, and confiscation, must be very considerable, though there is no possibility to make any other conjecture of its real amount than that it must be an immense one. Another considerable branch is the piratical trade, which brings the greater income into his treasury, as he is not at any expence either for fitting out of corsair vessels, or maintaining their men; and yet has the tenth of all the cargo and of all the captives; besides which, he appropriates to himself all the rest of them, by paying the captors 50 crowns per head, by which means he engrosses all the slaves to his own service and advantage. This article is indeed a very considerable addition to his revenue, not only as he sells their ransom at a very high rate, but likewise as he has the profit of all their labour, without allowing them any other maintenance than a little bread and oil, or any other assistance when sick, than what medicines a Spanish convent, which he tolerates there, gives them gratis; and which, nevertheless is forced to pay him an annual present for that toleration, besides furnishing the court with medicines, and the slaves with lodging and diet when they are not able to work. Another branch of his revenue consists in the tenth part of all cattle, corn, fruits, honey, wax, hides, rice, and other products of the earth, which is exacted of the Arabs and Brebes, as well as of the natives; and these are levied, or rather farmed, by the bashaws, governors, alcaides, &c. with all possible severity. The Jews and Christians likewise pay an income or capitation, the former of six crowns *per* head on all males from 15 years and upwards, besides other arbitrary imposts, fines, &c. That on the Christians, for the liberty of trading in his dominions, rises and falls according to their number, and the commerce they drive; but which, whatever it may bring yearly into his coffers, is yet detrimental to trade in general, seeing it discourages great numbers from settling there, notwithstanding the artful invitations which the emperors and their ministers make use of to invite them to it; for, besides those arbitrary exactions, there is still another great hardship attending them, viz. that they cannot leave the country without forfeiting all their debts and effects to the crown. The duties on all imports and exports is another branch of his income, the amount of which, it is said, does not exceed 165,000l. per annum.

Morocco.

8 Climate of Morocco.

The climate of the empire of Morocco is in general sufficiently temperate, healthy, and not so hot as its situation might lead us to suppose. The chain of mountains which form Atlas, on the eastern side, defends it from the east winds, that would scorch up the earth were they frequent. The summit of these mountains is always covered with snow; and their abundant descending streams spread verdure through the neighbourhood, make the winter more cold, and temper the heats of summer. The sea on the west side, which extends along the coast from north to south, also refreshes the land with regular breezes, that seldom vary according to their seasons. At a distance from the sea, within land, the heat is so great, that the rivulets become dry in summer; but as in hot countries dews are plentiful, the nights are there always cool. The rains are tolerably regular in winter; and are even abundant, though the atmosphere is not loaded with clouds as in northern latitudes. Those rains which fall by intervals are favourable to the earth, and increase its fecundity. In January the country is covered with verdure, and enamelled with flowers. Barley is cut in March, but the wheat harvest is in June. All fruits are early in this climate; and in forward years the vintage is over in the beginning of September. Though in general there is more uniformity and less variation in hot than in northern climates, the first are nevertheless exposed to the intemperance of weather: too heavy rains often impede the harvest; and drought has still greater inconveniences, for it ensures the propagation of locusts.

9 Soil, and

The soil of Morocco is exceedingly fertile. It is most so in the inland provinces. On the western coast it is in general light and stony, and is better adapted to the vine and olive than the culture of wheat. They annually burn, before the September rains, the stubble, which is left rather long; and this and the dung of cattle, every day turned to pasture, form the sole manure the land receives. The soil requires but little labour and the ploughing is so light that the furrows are scarcely six inches deep; for which reason, in some provinces, wooden ploughshares are used for cheapness.

10 productions.

The empire of Morocco might supply itself with all necessaries, as well from the abundance and nature of its products, as from the few natural or artificial wants of the Moors occasioned by climate or education. Its wealth consists in the fruitfulness of its soil: its corn, fruits,

Morocco. fruits, flocks, flax, salt, gums, and wax, would not only supply its necessities, but yield a superflux, which might become an object of immense trade and barter with other nations. Such numerous exports might return an inexhaustible treasure, were its government fixed and secure, and did subjects enjoy the fruits of their labour and their property in safety. The increase of corn in Morocco is often as sixty to one, and thirty is held to be but an indifferent harvest.

The Moors, naturally indolent, take little care of the culture of their fruits. Oranges, lemons, and thick skinned fruits, the trees of which require little nurture, grow in the open fields; and there are very large plantations of them found, which they take the trouble to water in order to increase their product. Their vines, which yield excellent grapes, are planted as far as the 33d degree, as in the southern provinces of France, and are equally vigorous. But at Morocco, where they yield a large and delicious grape, they are supported by vine poles five and six feet above ground; and as they are obliged to be watered, the little wine made there is seldom preserved. Figs are very good in some parts of the empire, but toward the south they are scarcely ripe before they are full of worms; the heats and night dews may, perhaps, contribute to this speedy decay. Melons, for the same reason, are rarely eatable; they have but a moment of maturity; which passes so rapidly that it is with difficulty seized. Water melons are everywhere reared, and in some provinces are excellent. Apricots, apples, and pears, are in tolerable plenty in the neighbourhood of Fez and Mequinez, where water is less scarce and the climate more temperate. But in the plain, which extends along the western coast, these delicate fruits are very indifferent, have less juice or taste, and the peaches there do not ripen. The tree called the prickly pear, or the Barbary fig, is plentifully found in the empire of Morocco; and is planted round vineyards and gardens, because its thick and thorny leaves, which are wonderfully prolific, form impenetrable hedges. From these leaves a fruit is produced, covered with a thorny skin, that must be taken off with care. This fruit is mild, and full of very hard, small kernels. The olive is everywhere found along the coast, but particularly to the south.

In the province of Suz, between the 25th and 30th degrees, the inhabitants have an almond harvest, which varies little because of the mildness of the climate; but the fruit is small, for which reason they take little care of the trees, and they degenerate with time. The palm-tree is common in the southern provinces of Morocco; but dates ripen there with difficulty, and few are good except in the province of Suz and toward Tafilet. On the coast of Sallee and Mamora there are forests of oak, which produce acorns near two inches long. They taste like chesnuts, and are eaten raw and roasted. Salt abounds in the empire, and in some places on the coast requires only the trouble of gathering. Independent of the salt pits formed by the evaporation of the soft water, there are pits and lakes in the country whence great quantities are obtained. It is carried even as far as Tombut, whence it passes to the interior parts of Africa.

The Moors cultivate their lands only in proportion to their wants; hence two-thirds of the empire at least lie waste. Here the *doum*, that is, the fan or wild palm tree, grows in abundance: and from which those people, Morocco. when necessity renders them industrious, find great advantage. The shepherds, mule-drivers, camel-drivers, and travellers, gather the leaves, of which they make mats, fringes, baskets, hats, *shoaris* or large wallets to carry corn, twine, ropes, girths, and covers for their pack saddles. This plant, with which also they heat their ovens, produces a mild and resinous fruit that ripens in September and October. It is in form like the raisin, contains a kernel, and is astringent and very proper to temper and counteract the effects of the watery and laxative fruits, of which these people in summer make an immoderate use.

11 Mines. Unacquainted with the sources of wealth of which their ancestors were possessed, the Moors pretend there are gold and silver mines in the empire, which the emperors will not permit to be worked, lest their subjects should thus find means to shake off their yoke. It is not improbable but that the mountains of Atlas may contain unexplored riches; but there is no good proof that they have ever yielded gold and silver. There are known iron mines in the south; but the working of them has been found so expensive, that the natives would rather use imported iron, notwithstanding the heavy duty it pays, by which its price is doubled. There are copper mines in the neighbourhood of Santa Cruz, which are not only sufficient for the small consumption of the empire, where copper is little used, but are also an object of exportation, and would become much more so were the duties less immoderate.

12 Animals. Neither the elephant nor the rhinoceros is to be found either in this or the other states of Barbary; but the deserts abound with lions, tigers, leopards, hyænas, and monstrous serpents. The Barbary horses were formerly very valuable, and thought equal to the Arabian. Though the breed is now said to be decayed, yet some very fine ones are occasionally imported into England. Camels and dromedaries, asses, mules, and kumrahs (a most serviceable creature, begot by an ass upon a cow), are their beasts of burden. Their cows are but small, and barren of milk. Their sheep yield but indifferent fleeces, but are very large, as are their goats. Bears, porcupines, foxes, apes, hares, rabbits, ferrets, weasels, moles, chameleons, and all kinds of reptiles, are found here. Partridges and quails, eagles, hawks, and all kinds of wild fowl, are frequent on the coast.

13 Mountains &c. The principal mountains form the chain which goes under the name of *Mount Atlas*, and runs the whole length of Barbary from east to west, passing through Morocco, and abutting upon that ocean which separates the eastern from the western continent, and is from this mountain called the *Atlantic Ocean*. See ATLAS. The principal rivers, besides the Malva or Mulvya above mentioned, which rises in the deserts, and running from south to north divides Morocco from the kingdom of Algiers, are the Suz, Onimirabih, Rabbata, Larache, Darodt, Sebon, Gueron, and Tensift, which rise in Mount Atlas, and fall into the Atlantic ocean.

14 Inland traffic. The traffic of the empire by land is either with Arabia or Negroland: to Mecca, they send caravans, consisting of several thousand camels, horses, and mules, twice every year, partly for traffic, and partly on a religious account; for numbers of pilgrims take that opportunity of paying their devotions to their great prophet. The goods they carry to the east are woollen manufactures,

Morocco. manufactures, leather, indigo, cochineal, and ostrich feathers; and they bring back from thence, silk, muslins, and drugs. By their caravans to Negroland, they send salt, silk, and woollen manufactures, and bring back gold and ivory in return, but chiefly negroes.

15 Traffic. The caravans always go strong enough to defend themselves against the wild Arabs in the deserts of Africa and Asia; though, notwithstanding all their vigilance, some of the stragglers and baggage often fall into their hands: they are also forced to load one-half of their camels with water, to prevent their perishing with drought and thirst in those inhospitable deserts. And there is still a more dangerous enemy, which is the sand itself: when the winds rise, the caravan is perfectly blinded with dust; and there have been instances both in Africa and Asia, where whole caravans, and even armies, have been buried alive in the sands.

16 Foreign commerce. The natives have hardly any trading vessels, but are seldom without some corsairs. These, and European merchant ships, bring them whatever they want from abroad; as linen and woollen cloth, stuffs, iron wrought and unwrought, arms, gunpowder, lead and the like: for which they take in return, copper, wax, hides, Morocco leather, wool (which is very fine), gums, soap, dates, almonds and other fruits. The duties paid by the English in the ports of Morocco are but half those paid by other Europeans. It is a general observation, that no nation is fond of trading with these states, not only on account of their capricious despotism, but the villany of their individuals, both natives and Jews, many of whom take all opportunities of cheating, and when detected are seldom punished.

17 Land forces. The land forces of the emperor of Morocco consist principally of black troops, and some few white; amounting altogether to an army of about 36,000 men upon the establishment, two-thirds of which are cavalry. This establishment, however, upon occasion, admits of a considerable increase, as every man is supposed to be a soldier, and when called upon is obliged to act in that capacity. About 6000 of the standing forces form the emperor's body guard, and are always kept near his person; the remainder are quartered in the different towns of the empire, and are under the charge of the bashaws of the provinces. They are all clothed by the emperor, and receive a trifling pay; but their chief dependence is on plunder, which they have frequent opportunities of acquiring.

The black troops are naturally of a very fiery disposition, capable of enduring great fatigue, hunger, thirst, and every difficulty to which a military life is exposed. They appear well calculated for skirmishing parties, or for the purpose of harassing an enemy; but were they obliged to undergo a regular attack, from their total want of discipline they would soon be routed. In all their manœuvres they have no notion whatever of order and regularity, but have altogether more the appearance of a rabble than of an army.

18 Navy. The emperor's navy consists of about 15 small frigates, a few xebecks, and between 20 and 30 row-galleys. The whole is commanded by one admiral; but as these vessels are principally used for the purposes of piracy, they seldom unite in a fleet. The number of the seamen in service is computed at 6000.

Morocco. The coins of this empire are a fluce, a blanquil, and ducat. The fluce is a small copper coin, 20 whereof make a blanquil, of the value of twopence sterling. The blanquil is of silver, and the ducat of gold, not unlike that of Hungary, and worth about nine shillings. Both these pieces are so liable to be clipped and filed by the Jews, that the Moors always carry scales in their pockets to weigh them; and when they are found to be much diminished in their weight, they are recoined by the Jews, who are masters of the mint, by which they gain a considerable profit; as they do also by exchanging the light pieces for those that are full weight. Merchants accounts are kept in ounces, 10 of which make a ducat; but in payments to the government, it is said they reckon 17 one-half for a ducat.

19 Coins.

20 Religion and With respect to religion, the inhabitants of Morocco are Mohammedans, of the sect of Ali; and have a mufti or high-priest, who is also the supreme civil magistrate, and the last resort in all causes ecclesiastical and civil. They have a great veneration for their hermits, and for idiots and madmen; as well as for those who by their tricks have got the reputation of wizzards: all whom they look upon as inspired persons, and not only honour as saints while they live, but build tombs and chapels over them when dead; which places are not only religiously visited by their devotees far and near, but are esteemed inviolable sanctuaries for all sorts of criminals except in cases of treason.

Notwithstanding the natives are zealous Mohammedans, they allow foreigners the free and open profession of their religion, and their very slaves have their priests and chapels in the capital city; though it must be owned that the Christian slaves are here treated with the utmost cruelty. Here, as in all other Mohammedan countries, the Alcoran and their comments upon it are their only written laws; and though in some instances their cadis and other civil magistrates are controlled by the arbitrary determinations of their princes, bashaws, generals, and military officers, yet the latter have generally a very great deference and regard for their laws. Murder, theft, and adultery, are commonly punished with death: and their punishments for other crimes, particularly those against the state, are very cruel; as impaling, dragging the prisoner through the streets at a mule's heels till all his flesh is torn off, throwing him from a high tower upon iron hooks.

21 Laws.

22 Inhabitants of the empire of Morocco. The inhabitants of the empire of Morocco, known by the name of *Moors*, are a mixture of Arabian and African nations formed into tribes; with the origin of whom we are but imperfectly acquainted. These tribes, each strangers to the other, and ever divided by traditional hatred or prejudice, seldom mingle. It seems probable that most of the casts who occupy the provinces of Morocco have been repulsed from the eastern to the western Africa, during those different revolutions by which this part of the world has been agitated; that they have followed the standard of their chiefs, whose names they have preserved; and that by these they, as well as the countries they inhabit, are distinguished. At present these tribes are called *cafiles* or *cabiles*, from the Arabic word *kobeila*; and they are so numerous, that it is impossible to have a knowledge of them all.

The

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The native subjects of the empire of Morocco may be divided into two principal classes; the *Brebes* and the *Moors*.

23 The Brebes, or Mountaineers.

The etymology of the name, and the origin of the people, of the first class, are equally unknown. Like the Moors, at the time of the invasion by the Arabs, they may have adopted the Mahometan religion, which is consonant to their manners and principal usages; but they are an ignorant people, and observe none of the precepts of that religion, but the aversion it enjoins against other modes of worship.

Confined to the mountains, the Brebes preserve great animosity against the Moors, whom they confound with the Arabs, and consider as usurpers.—They thus contract in their retreats a ferocity of mind, and a strength of body, which makes them more fit for war and every kind of labour than the Moors of the plain in general are. The independence they boast of gives even a greater degree of expression to their countenance. The prejudices of their religion make them submit to the authority of the emperors of Morocco; but they throw off the yoke at their pleasure, and retire into the mountains, where it is difficult to attack or overcome them. The Brebes have a language of their own, and never marry but among each other. They have tribes or cafiles among them who are exceedingly powerful both by their number and courage.

The *Moors* of the plains may be distinguished into those who lead a pastoral life, and those who inhabit the cities.

24 The Moors of the country.

The former live in tents; and that they may allow their ground a year's rest, they annually change the place of their encampments, and go in search of fresh pasturage; but they cannot take this step without acquainting their governor. Like the ancient Arabs, they are entirely devoted to a pastoral life: their encampments, which they call *douchars*, are composed of several tents, and form a crescent; or they are ranged in two parallel lines, and their flocks, when they return from pasture, occupy the centre.

The tents of the Moors, viewed in front, are of a conical figure; they are from 8 to 10 feet high, and from 20 to 25 feet long; like those of high antiquity, they resemble a boat reversed. They are made of cloth composed of goats and camel's hair, and the leaves of the wild palm, by which they are rendered impervious to water; but at a distance their black colour gives them a very disagreeable look.

25 Their simple way of life.

The Moors, when encamped, live in the greatest simplicity, and exhibit a faithful picture of the inhabitants of the earth in the first ages of the world. The nature of their education, the temperature of the climate, and the rigour of the government, diminish the wants of the people, who find in their plains, in the milk and wool of their flocks, every thing necessary for food and clothing. Polygamy is allowed among them; a luxury so far from being injurious to a people who have few wants, that it is a great convenience in the economy of those societies, because the women are intrusted with the whole care of the domestic management. In their half-closed tents, they are employed in milking the cows for daily use; and when the milk abounds, in making butter, in picking their corn, their barley, and pulse, and grinding their meal, which they do daily in a mill composed of two stones about 18 inches in diameter, the uppermost having a handle, and turning on an axis fixed in the under one: they make bread likewise every day, which they bake between two earthen plates, and often upon the ground after it has been heated by fire. Their ordinary food is the cooscoosoo; which is a paste made with their meal in the form of small grains like Italian paste. This cooscoosoo is dressed in the vapour of boiling soup, in a hollow dish perforated with many small holes in the bottom, and the dish is enclosed in a kettle where meat is boiled; the cooscoosoo, which is in the hollow dish, grows gradually soft by the vapour of the broth, with which it is from time to time moistened. This simple food is very nourishing, and even agreeable when one has got the better of the prejudices which every nation entertains for its own customs. The common people eat it with milk or butter indifferently; but those of higher rank, such as the governors of provinces and lieutenants, who live in the centre of the encampments, add to it some succulent broth, made with a mixture of mutton, poultry, pigeons, or hedgehogs, and then pour on it a sufficient quantity of fresh butter.

26 Occupations of the women, &c.

The women in their tents spin wool, and weave it into cloth on looms suspended the whole length of the tent. Each piece is about five ells long, and one and a half broad; it is neither dressed nor dyed, and it has no seam; they wash it when it is dirty; and as it is the only habit of the Moors, they wear it night and day. It is called *haick*, and is the true model of the ancient draperies.

27 Dress, &c.

The Moors of the plain wear nothing but their woollen stuff; they have neither shirts nor drawers. Linen among these people is a luxury known only to those of the court or the city. The whole wardrobe of a country Moor in easy circumstances consists in a haick for winter, another for summer, a red cap, a hood, and a pair of slippers. The common people both in the country and in towns wear a kind of tunic of woollen cloth, white, gray, or striped, which reaches to the middle of the leg, with great sleeves and a hood; it resembles the habit of the Carthusians.

The women's dress in the country is likewise confined to a haick, which covers the neck and the shoulders, and is fastened with a silver clasp. The ornaments they are fondest of are ear rings, which are either in the form of rings or crescents, made of silver, bracelets, and rings for the small of the leg; they wear these trinkets at their most ordinary occupations; less out of vanity than because they are unacquainted with the use of caskets or cabinets for keeping them. They also wear necklaces made of coloured glass beads or cloves strung on a cord of silk.

The Moors consider their wives less in the light of companions than in that of slaves destined to labour. Except in the business of tillage, they are employed in every servile operation; nay, in some of the poorer quarters a woman is often seen yoked in a plough along with a mule, an ass, or some other animal. When the Moors remove their douchars, all the men seat themselves in a circle on the ground; and with their elbows resting on their knees, pass the time in conversation, while the women strike the tents, fold them up into bundles, and place them on the backs of their camels or oxen. The old women are then each loaded with a parcel, and the young carry the children on their shoulders

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shoulders suspended in a cloth girt round their bodies. In the more southern parts the women are likewise employed in the care of the horses: the husband, who in these climates is always a despot, issues his orders, and seems only made to be obeyed.

28 Marriages, &c.

The marriage ceremonies of the Moors that live in tents pretty much resemble those of the same people that live in the cities. In the douchars they are generally most brilliant and gay; the strangers that pass along are invited, and made to contribute to the feast; but this is done more from politeness than from any mercenary motive.

The tribes of the plain generally avoid mixing by marriage with one another: the prejudices that divide these people are commonly perpetuated; or, if they are partially healed, they never fail to revive upon trifling occasions, such as a strayed camel, or the preference of a pasture or a well. Marriages have sometimes taken place among them, that, so far from cementing their differences, have occasioned the most tragical scenes. Husbands have been known to murder their wives, and women their husbands, to revenge national quarrels.

Parents are not encumbered with their children, however numerous they may be, for they are very early employed in domestic affairs; they tend the flocks, they gather wood, and they assist in ploughing and reaping. In the evening, when they return from the field, all the children of the douchar assemble in a common tent, where the iman, who himself can hardly spell, makes them read a few sentences from the Koran written on boards, and instructs them in their religion by the light of a fire, made of straw, of bushes, and cow dung dried in the sun. As the heat is very great in the inland parts of the country, children of both sexes go quite naked till the age of nine or ten.

29 Entertainment of travellers.

The douchars dispersed over the plains are always in the neighbourhood of some rivulet or spring, and they are a kind of inns for the reception of travellers. There is generally a tent erected for their use, if they have not brought one along with them, where they are accommodated with poultry, milk, and eggs, and with whatever is necessary for their horses. Instead of wood for fuel, they have the cow dung, which, when mixed with charcoal, makes a very brisk fire. A guard is always set on the tents of travellers, especially if they are Europeans, because the opinion of their wealth might tempt the avidity of the Moors, who are naturally inclined to thieving.

With respect to the roads, a very judicious policy is established, which is adapted to the character of the Moors, and to their manner of life. The douchars are responsible for robberies committed in their neighbourhood and in sight of their tents: they are not only obliged to make restitution, but it gives the sovereign a pretence for exacting a contribution proportioned to the abilities of the douchar. In order to temper the rigour of this law, they are made responsible only for such robberies as are committed during the day; those that happen after sunset are not imputed to them, as they could neither see nor prevent them: on this account, people here travel only from sunrising to sunsetting.

30 Markets.

To facilitate the exchange of necessaries, there is in the fields every day, except Friday, which is a day of prayer, a public market in the different quarters of each province. The Moors of the neighbourhood assemble to sell and buy cattle, corn, pulse, dried fruits, carpets, haicks, and in short all the productions of the country. This market, which is called *Soc*, resembles our fairs. The bustle of the people who go and come, gives a better idea of the manner of life of the Moors than can be had in the cities. The alcaides, who command in the neighbourhood, always attend these markets with soldiers to keep the peace; as it frequently happens that the grudges which these tribes harbour against one another break out upon such occasions into open violence.

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31 Of the Moors who dwell in cities.

The Moors who inhabit the cities differ from the others only in having a little more urbanity and a more easy deportment. Though they have the same origin with those of the plains, they affect to decline all intercourse with them. Some writers, without any foundation, have given the name of *Arabs* to the inhabitants of the towns, and that of *Moors* to those of the plains. But the greater part of the cities of this empire are more ancient than the invasion of the Arabs, who themselves lived in tents.

32 Their houses and furniture.

The houses in most of the towns in this empire appear at a little distance like vaulted tombs in a churchyard; and the entrance into the best of them has but a mean appearance. The rooms are generally on the ground floor, and whitened on the outside. As the roofs are quite flat, they serve as *verandas*, where the Moorish women commonly sit for the benefit of the air; and in some places it is possible to pass nearly over the whole town without having occasion to descend into the street.

As the best apartments are all backwards, a stable, or perhaps something worse, is the place to which visitors are first introduced. Upon entering the house, the stranger is either detained in this place, or in the street, till all the women are despatched out of the way; he is then allowed to enter a square court, into which four narrow and long rooms open by means of large folding doors, which, as they have no windows, serve likewise to introduce light into the apartments. The court has generally in its centre a fountain; and if it is the house of a Moor of property, it is floored with blue and white chequered tiling. None of the chambers have fire places; and their victuals are always dressed in the court-yard in an earthen stove heated with charcoal. When the visitor enters the room, where he is received by the master of the house, he finds him sitting cross-legged and barefooted on a mattress, covered with fine white linen, and placed on the floor or else on a common mat. This, with a narrow piece of carpeting, is in general the only furniture he will meet with in Moorish houses, though they are not destitute of other ornaments.

33 Dress of the men.

The wardrobe of the inhabitants of cities is but little different from that of those who live in tents.—Like the latter, they have a haick, and a hood more or less fine, and have also a hood of coarse European cloth of dark blue for the winter. What farther distinguishes them from the country Moors is, that they wear a shirt and linen drawers, and an upper garment of cotton in summer, and of cloth in winter, which they call a *caftan*. The white or blue hood, the purpose of which seems to be to guard against bad weather, and which is called *bernus*,

Morocco. *bernus*, is likewise a ceremonial part of dress; without which, together with sabre and canjer (or dagger) worn in a bandelier, persons of condition never appear before the emperor.

34 Dress of the ladies. The Moorish women who live in cities are, as in other nations, more addicted to show and finery in dress than those of the country; but as they generally leave the house only one day in the week, they seldom dress themselves. Not allowed to receive male visitors, they remain in their houses employed in their families, and so totally in deshabile that they often wear only a shift, and another coarser shift over the first, tied round their waist, with their hair plaited, and sometimes with, though often without, a cap. When dressed, they wear an ample and fine linen shift, the bosom embroidered in gold; a rich caftan of cloth, stuff, or velvet, worked in gold; and one or two folds of gauze, streaked with gold and silk, round the head, and tied behind so as that the fringes, intermingled with their tresses, descend as low as the waist; to which some add a ribband of about two inches broad, worked in gold or pearls, that encircles the forehead in form of a diadem. Their caftan is bound round their waist by a crimson velvet girdle, embroidered in gold, with a buckle of gold or silver, or else a girdle of tamboured stuff, manufactured at Fez.

The women have yellow slippers, and a custom of wearing a kind of stocking of fine cloth somewhat large, which is tied below the knee and at the ankle, over which it falls in folds. This stocking is less calculated to show what we call a handsome leg, than to make it appear thick; for to be fat is one of the rules of beauty among the Moorish women. To obtain this quality, they take infinite pains, feed when they become thin on a diet somewhat like forced meat balls, a certain quantity of which is given them daily; and in fine, the same care is taken among the Moors to fatten young women as is in Europe to fatten fowls.

35 Negroes. The *Negroes*, who constitute a large proportion of the emperor's subjects, are better formed than the Moors; and as they are more lively, daring, and active, they are intrusted with an important share in the executive part of government. They constitute in fact the most considerable part of the emperor's army, and are generally appointed to the command of provinces and towns. This circumstance naturally creates a jealousy between them and the Moors, the latter considering the negroes as usurpers of a power which they have no right to assume. Besides those negroes which form the emperor's army, there are a great many others in the country, who either are or have been slaves to private Moors: every Moor of consequence, indeed, has his proportion of them in his service. To the disgrace of Europe, the Moors treat their slaves with humanity, employing them in looking after their gardens, and in the domestic duties of their houses. They allow them to marry among themselves; and after a certain number of years, spontaneously present them with the invaluable boon of liberty. They soon are initiated in the Mahometan persuasion, though they sometimes intermix with it a few of their original superstitious customs. In every other respect they copy the dress and manners of the Moors.

36 Renegadoes. Among the inhabitants of Morocco there is another class, of whom we must not omit to make mention. These are the *Renegadoes*, or foreigners, who have renounced their religion for the faith of Mahomet. Of these there are a great number who have been originally Jews: they are held in little estimation by the Moors; and would be held in abhorrence by the Jews, if they durst freely express their aversion. The families of these apostates are called *Toornadis:* not having at any time married with the Moors, they still preserve their ancient characteristics, and are known almost at sight to be the progeny of those who formerly embraced the Mahometan religion. The Christian renegadoes are but few; and generally are fugitive peculators of Spain, or men fallen from power, who because of their misconduct, or in despair, quit one unfortunate situation for another much more deplorable. Morocco.

37 Jews. The *Jews* were formerly very numerous in this empire. After being proscribed in Spain and Portugal, multitudes of them passed over to Morocco, and spread themselves through the towns and over the country. By the relations they themselves give, and by the extent of the places assigned them to dwell in, it would appear there were more than 30,000 families, of whom at present there is scarcely a residue of one-twelfth; the remainder either having changed their religion, sunk under their sufferings, or fled from the vexations they endured, and the arbitrary taxes and tolls imposed upon them. The Jews possess neither lands nor gardens, nor can they enjoy their fruits in tranquillity: they must wear only black; and are obliged, when they pass near mosques, or through streets in which there are sanctuaries, to walk barefoot. The lowest among the Moors imagines he has a right to ill-treat a Jew; nor dares the latter defend himself, because the Koran and the judge are always in favour of the Mahometan.—Notwithstanding this state of oppression, the Jews have many advantages over the Moors: they better understand the spirit of trade; they act as agents and brokers, and profit by their own cunning and the ignorance of the Moors.

38 State of knowledge among the Moors. The Moors, who derive their language and religion from the Arabs, seem not in any manner to have participated of their knowledge. United and confounded as those of Morocco have been with the Moors of Spain, the latter of whom cultivated the arts and gave birth to Averroes, and many other great men, the Moors of this empire have preserved no traces of the genius of their ancestors. They have no conception of the speculative sciences. Education consists merely in learning to read and write; and as the revenues of the learned are derived from these talents, the priests and talbes among them are the sole depositories of thus much knowledge: the children of the Moors are taught in their schools to read and repeat some sixty lessons, selected from the Koran, which for the sake of economy are written upon small boards.

The Moors who formerly inhabited Spain gave great application to physic and astronomy; and they have left manuscripts behind them which still remain monuments of their genius. The modern Moors are infinitely degenerate; they have not the least inclination to the study of science; they know the properties of some simples; but as they do not proceed upon principle, and are ignorant of the causes and effects of diseases, they generally make a wrong application of their remedies. Their most useful physicians are their talbes, their fakirs,

Morocco. kirs, and their saints, in whom they place a superstitious confidence.

Notwithstanding the Moors have occupied themselves little in the study of astronomy, they have been eager after astrology. This imaginary science, which made so rapid a progress at Rome in spite of the edicts of the emperors, may be conceived to make still greater advances among a people wholly stupid and ignorant, and ever agitated by the dread of present evils, or the hope of a more happy futurity. Magic, the companion of astrology, has here also found its followers, and is particularly studied by the talbes in the southern parts, who successfully use it in imposing upon Moorish credulity with strange dreams and ambiguous forebodings and prophecies.

39 Manufactures and trades. The Moorish manufactures are—The haick, which as was before observed, is a long garment composed of white wool and cotton, or cotton and silk woven together, and is used by the Moors for the purpose of covering their under dress when they go abroad, which they do by totally wrapping themselves in it in a careless but easy manner; silk handkerchiefs of a particular kind, prepared only at Fez; silks chequered with cotton; carpeting, little inferior to that of Turkey; beautiful matting, made of the palmetto or wild palm tree; paper of a coarse kind; cordovan, commonly called *Morocco leather;* gunpowder of an inferior nature; and long-barrelled muskets, made of Biscay iron. The Moors are unacquainted with the mode of casting cannon: and therefore those few which are now in the country are obtained from Europeans.—The manufacture of glass is likewise unknown to them; as indeed they make great use of earthen ware, and have few or no windows to their houses, this commodity may be of less importance to them than many others. They make butter, by putting the milk into a goat skin, with its outward coat turned inwards, and shaking it till the butter collects on the sides, when it is taken out for use. From this operation it proves always full of hairs, and has an insipid flavour. Their cheese consists merely of curds hardened and dried, and has uniformly a disagreeable taste. The bread in some of the principal towns, particularly at Tangier and Sallee, is remarkably good, but in many other places it is coarse, black, and heavy.

Their looms, forges, ploughs, carpenters tools, &c. are much upon the same construction with the unimproved instruments of the same kind which are used at this time in some parts of Europe, only still more clumsily finished. In their work, they attend more to strength than neatness or convenience; and, like all other ignorant people, they have no idea that what they do is capable of improvement. It is probable, indeed, that the Moors have undergone no very material change since the revolution in their arts and sciences, which took place soon after their expulsion from Spain. Previous to that period, it is well known they were an enlightened people, at a time when the greater part of Europe was involved in ignorance and barbarism; but owing to the weakness and tyranny of their princes, they gradually sunk into the very opposite extreme, and may now be considered as but a few degrees removed from a savage state.

Their mosques or places of public worship are usually large square buildings, composed of the same materials as the houses. The building consists of broad and lofty piazzas, opening into a square court, in a manner in some degree similar to the Royal Exchange of London. In the centre of the court is a large fountain; and a small stream surrounds the piazzas, where the Moors perform the ceremony of ablution. The court and piazzas are floored with blue and white chequered tiling; and the latter are covered with matting, upon which the Moors kneel while repeating their prayers. In the most conspicuous part of the mosque fronting the east, stands a kind of pulpit, where the talbe or priest occasionally preaches. The Moors always enter this place of worship barefooted, leaving their slippers at the door. On the top of the mosque, is a square steeple with a flag staff, whither at stated hours the talbe ascends, hoists a white flag, and calls the people to prayers, for they have no bells. From this high situation the voice is heard at a considerable distance; and the talbes have a monotonous mode of enunciation, the voice sinking at the end of every short sentence, which in some measure resembles the sound of a bell. The moment the flag is displayed, every person forsakes his employment, and goes to prayers. If they are near a mosque, they perform their devotions within it, otherwise immediately on the spot where they happen to be, and always with their faces towards the east, in honour of their prophet Mahomet, who it is well known was buried at Medina. Morocco.

40 Religious ceremonies.

Their Sabbath is on our Friday, and commences from six o'clock the preceding evening. On this day they use a blue flag instead of the white one. As it has been prophesied that they are to be conquered by the Christians on the Sabbath day, the gates of all the towns and of the emperor's palaces are shut when at divine service on that day, in order to avoid being surprised during that period. Their talbes are not distinguished by any particular dress.

The Moors have three solemn devotional periods in the course of the year. The first, which is named *Aid de Cabier*, is held in commemoration of the birth of Mahomet. It continues seven days; during which period, every person who can afford the expence kills a sheep as a sacrifice, and divides it among his friends. The second is the *Ramadam*. This is held at the season when Mahomet disappeared in his flight from Mecca to Medina. Every man is obliged at that period to fast (that is, to abstain from animal food from sunrise to sunset each day) for 30 days; at the expiration of which time a feast takes place, and continues a week. The third is named *Llashore*, and is a day set apart by Mahomet for every person to compute the value of his property, in order for the payment of *zakat*, that is, one-tenth of their income to the poor, and other pious uses. Although this feast only lasts a single day, yet it is celebrated with far greater magnificence than either of the others.

The Moors compute time by lunar months, and count the days of the week by the first, second, third, &c. beginning from our Sunday. They use a common reed for writing, and begin their manuscripts from right to left.

41 Language of the Moors. The Moors of the empire of Morocco, as well as those to the northern limits of Africa, speak Arabic; but this language is corrupted in proportion as we retire farther from Asia, where it first took birth; the

Morocco. intermixture which has happened among the African nations, and the frequent transmigrations of the Moors, during a succession of ages, have occasioned them to lose the purity of the Arabic language; its pronunciation has been vitiated, the use of many words lost, and other foreign words have been introduced without thereby rendering it more copious; the pronunciation of the Africans, however, is softer to the ear and less guttural than that of the Egyptians. The language, when written, is in effect much the same at Morocco as at Cairo, except that there are letters and expressions among the Moors which differ from those of the Oriental Arabs, who, however, understand the Moors in conversation, notwithstanding their vitiated manner of pronouncing. They mutually read each others writings with some difficulty.

42 Their temper and disposition. The Moors are naturally of a grave and pensive disposition, fervid in professions of friendship, but very insincere in their attachments. They have no curiosity, no ambition of knowledge; an indolent habit, united to the want of mental cultivation, renders them perhaps even more callous than other unenlightened people to every delicate sensation; and they require more than ordinary excitement to render them sensible of pleasure or of pain. This languor of sentiment is, however, unaccompanied with the smallest spark of courage or fortitude. When in adversity, they manifest the most abject submission to their superiors; and in prosperity their tyranny and pride are insupportable.

43 Mode of living, manners, &c. Personal cleanliness has been considered as one of those circumstances which serve to mark and determine the civilization of a people. It was in vain that Mahomet enjoined the frequency of ablution as a religious duty to the Moors. Their dress, which should be white, is but seldom washed; and their whole appearance evinces that they perform this branch of their religious ceremonies in but a slovenly manner. With this degree of negligence as to their persons, we may be justly surprised to find united a most scrupulous nicety in their habitations and apartments. They enter their chambers barefooted, and cannot bear the slightest degree of contamination near the place where they are seated. This delicacy again is much confined to the insides of their houses. The streets receive the whole of their rubbish and filth; and by these means the ground is so raised in most parts of the city of Morocco, that the new buildings always stand considerably higher than the old.

With respect to the hours for eating, the people of this country are remarkably regular. Very soon after daybreak they take their breakfast, which is generally a composition of flour and water boiled thin, together with an herb which gives it a yellow tinge. The male part of the family eat in one apartment and the female in another. The children are not permitted to eat with their parents, but take their meals afterwards with the servants; indeed in most other respects they are treated exactly as servants or slaves by their parents. The mess is put into an earthen bowl, and brought in upon a round wooden tray. It is placed in the centre of the guests, who sit cross-legged either on a mat or on the floor, and who form a circle for the purpose. Having previously washed themselves, a ceremony always performed before and after meals, each person with his spoon attacks vigorously the bowl, while they diversify the entertainment by eating with it fruit or bread. At twelve o'clock they dine, performing the same ceremonies as at breakfast. For dinner, from the emperor down to the peasant, their dish is universally *cooscoosoo*, the mode of preparing which has been already described. The dish is brought in upon a round tray and placed on the floor, round which the family sit as at breakfast, and with their fingers commit a violent assault on its contents: they are at the same time, however, attended by a slave or domestic, who presents them with water and a towel occasionally to wash their hands. From the want of the simple and convenient invention of knives and forks, it is not uncommon in this country to see three or four people pulling to pieces the same piece of meat, and afterwards with their fingers stirring up the paste or *cooscoosoo*, of which they often take a whole handful at once into their mouth. At sunset they sup upon the same dish; and indeed supper is their principal meal. Morocco.

But the common people must content themselves with a little bread and fruit instead of animal food, and sleep in the open streets. This kind of existence seems ill calculated to endure even in an inactive state; far more severe must it therefore be to those who exercise the laborious employment of couriers in this country, who travel on foot a journey of three hundred or four hundred miles, at the rate of between thirty or forty miles a-day, without taking any other nourishment than a little bread, a few figs, and some water, and who have no better shelter at night than a tree. It is wonderful with what alacrity and perseverance these people perform the most fatiguing journeys at all seasons of the year. There is a regular company of them in every town, who are ready to be dispatched at a moment's warning to any part of the country their employers may have occasion to send them.

As the Moors are not fond of admitting men into their houses, except upon particular occasions, if the weather be fine they place a mat, and sometimes a carpet, on the ground before the door, seat themselves upon it cross-legged, and receive their friends, who form a circle, sitting in the same manner, with their attendants on the outside of the groupe. Upon these occasions they either drink tea or smoke and converse. The streets are sometimes crowded with parties of this kind; some engaged in playing at an inferior kind of chess or draughts, at which they are very expert; but the majority in conversation. The people of this country, indeed, are so decidedly averse to standing up, or walking about, that if only two or three people meet, they squat themselves down in the first clean place they can find, if the conversation is to hold but a for a few minutes.

44 Their amusements. The Moors have in general but few amusements; the sedentary life they lead in cities is little variegated except by the care they take of their gardens, which are rather kept for profit than pleasure. Most of these gardens are planted with the orange, the lemon tree, and the cedar, in rows, and in such great quantities, that the appearance is rather that of a forest than that of a garden. The Moors sometimes, though rarely, have music in these retreats: a state of slavery but ill agrees with the love of pleasure; the people of Fez alone, either from a difference in education, or because their organs and sensibility are more delicate,

make

Morocco. make music a part of their amusements. There are not in Morocco, as in Turkey, public coffee-houses, where people meet to inquire the news of the day; but instead of these, the Moors go to the barbers shops, which in all countries seem to be the rendezvous of newsmongers. These shops are surrounded by benches; on which the customer, the inquisitive, and the idle, seat themselves, and when there are no more places vacant, they crouch on the ground like monkeys.

A common diversion in the towns where there are soldiers, as well as in the country, is what the Moors call the game of gunpowder; a kind of military exercise, that is the more pleasing to these people, inasmuch as, by the nature of their government, they all are, or are liable to become, soldiers, therefore all have arms and horses. By explosions of powder, too, they manifest their festivity on their holidays. Their game of gunpowder consists in two bodies of horse, each at a distance from the other, galloping in successive parties of four and four, and firing their pieces charged with powder. Their chief art is in galloping up to the opposite detachment, suddenly stopping, firing their muskets, facing about, charging, and returning to the attack; all which manœuvres are imitated by their opponents. The Moors take great pleasure in this amusement, which is only an imitation of their military evolutions.

45 Management of horses. The common topics for conversation among the Moors, are the occurrences of the place, religion, their women, but above all their horses. This last topic, indeed, appears to occupy by far the greatest portion of their attention. These animals are seldom kept in stables in Morocco. They are watered and fed only once a-day, the former at one o'clock at noon, and the latter at sunset: and the only one mode which they use to clean them is by washing them all over in a river two or three times a-week, and suffering them to dry themselves.

46 Love of music. Like all barbarous nations, the Moors are passionately fond of music, and some few have a taste for poetry. Their slow airs, for want of that variety which is introduced when the science has attained a degree of perfection, have a very melancholy sameness; but some of their quick tunes are beautiful and simple, and partake in some degree of the characteristic melody of the Scotch airs. The poetry of their songs, the constant subject of which is love, though there are few nations perhaps who are less sensible of that passion, has certainly less merit than the music.

Their instruments are a kind of hautboy, which differs from ours only in having no keys; the mandoline, which they have learnt to play upon from their neighbours the Spaniards; another instrument, bearing some resemblance to a violin, and played upon in a similar manner, but with only two strings; the large drum, the common pipe, and the tabor. These united, and accompanied with a certain number of voices, upon many occasions form a band, though solo music is more common in this unsocial country.

The Moors marry very young, many of their females not being more than 12 years of age at their nuptials. As Mahometans, it is well known that their religion admits of polygamy to the extent of four wives, and as many concubines as they please; but if we except the very opulent, the people seldom avail themselves of this indulgence, since it entails on them a vast additional expence in house-keeping, and in providing for a large family. In contracting marriage, the parents of both parties are the only agents; and the intended bride and bridegroom never see each other till the ceremony is performed. The marriage settlements are made before the cadi; and then the friends of the bride produce her portion, or if not, the husband agrees to settle a certain sum upon her in case he should die, or divorce her on account of barrenness, or any other cause. The children of the wives have all an equal claim to the effects of the father and mother, but those of the concubines can each only claim half a share. Morocco

47 Marriage ceremonies.

When the marriage is finally agreed upon, the bride is kept at home eight days, to receive her female friends, who pay congratulatory visits every day. At the same time a talbe attends upon her, to converse with her relative to the solemn engagement on which she is about to enter: on these occasions he commonly accompanies his admonitions with singing a pious hymn, which is adapted to the solemnity. The bridegroom, on the other hand, receives visits from his male friends in the morning, and in the evening rides through the town accompanied by them, some playing on hautboys and drums, while others are employed in firing volleys of musketry. In all their festivals the discharge of musketry indeed forms a principal part of the entertainment. Contrary to the European mode, which particularly aims at firing with exactness, the Moors discharge their pieces as irregularly as possible, so as to have a continual succession of reports for a few minutes.

On the day of the marriage, the bride in the evening is put into a square or octagonal cage about twelve feet in circumference, which is covered with fine white linen, and sometimes with gauses and silks of various colours. In this vehicle, which is placed on a mule, she is paraded round the streets, accompanied by her relations and friends, some carrying lighted torches, others playing on the hautboys, and a third party again firing volleys of musketry. In this manner she is carried to the house of her intended husband, who returns about the same time from performing similar ceremonies. On her arrival, she is placed in an apartment by herself, and her husband is introduced to her alone for the first time, who finds her sitting on a silk or velvet cushion (supposing her to be a person of consequence), with a small table before her, upon which are two wax candles lighted. Her shift, or more properly shirt, hangs down like a train behind her, and over it is a silk or velvet robe with close sleeves, which at the breast and wrists is embroidered with gold; this dress reaches something lower than the calf of the leg. Round her head is tied a black silk scarf, which hangs behind as low as the ground. Thus attired, the bride sits with her hands over her eyes, when her husband appears, and receives her as his wife without any further ceremony: for the agreement made by the friends before the cadi is the only specific contract which is thought necessary.

If the husband should have any reason to suspect that his wife has not been strictly virtuous, he is at liberty to divorce her and take another. For some time after marriage, the family and the friends are engaged in much

Morocco. much feasting, and a variety of amusements, which last a longer or shorter time according to the circumstances of the parties. It is usually customary for the man to remain at home eight days and the woman eight months after they are first married; and the woman is at liberty to divorce herself from her husband, if she can prove that he does not provide her with a proper subsistence.

Women suffer but little inconvenience in this country from child-bearing; they are frequently up the next day, and go through all the duties of the house with the infant upon their backs. In celebrating the rite of circumcision, the child is dressed very sumptuously, and carried on a mule, or, if the parents are in poor circumstances, on an ass, accompanied with flags flying and musicians playing on hautboys and beating drums. In this manner they proceed to the mosque, where the ceremony is performed. Children, as soon as they can be made in the least degree useful, are put to the various kinds of labour adapted to their age and strength. Others, whose parents are in better circumstances, are sometimes sent to school; and those who are intended for the church, usually continue their studies till they have nearly learnt the Koran by rote. In that case they are enrolled among the talbes, or learned men of the law; and upon leaving school are paraded round the streets on a horse, accompanied by music and a large concourse of people.

48 Circumcision.

49 Education of children.

50 Funeral rites.

When any person dies, a certain number of women are hired for the purpose of lamentation; in the performance of which, nothing can be more grating to the ear, or more unpleasant, than their frightful moans, or rather howlings: at the same time, these mercenary mourners beat their heads and breasts, and tear their cheeks with their nails. The bodies are usually buried a few hours after death. Previous to interment, the corpse is washed very clean, and sewed up in a shroud, with the right hand under the head, which is pointed towards Mecca: it is carried on a bier supported upon men's shoulders, to the burying place, which is always, with great propriety, on the outside of the town, for they never bury their dead in the mosques, or within the bounds of an inhabited place.

Morocco, a city of the kingdom of Morocco in Barbary, lying about 120 miles to the north of Tarudant, 90 to the east of Mogodore, and 350 to the south of Tangier. It is situated in a beautiful valley, formed by a chain of mountains on the northern side, and those of Atlas, from which it is distant about 20 miles, on the south and east. The country which immediately surrounds it is a fertile plain, beautifully diversified with clumps of palm trees and shrubs, and watered by small and numerous streams which descend from Mount Atlas. The emperor's out gardens, which are situated at the distance of about five miles to the south of the city, and are large plantations of olives walled in, add considerably to the beauty of the scene.

Morocco, though one of the capitals of the empire (for there are three, Morocco, Mequinez, and Fez), has nothing to recommend it but its great extent and the royal palace. It is enclosed by remarkably strong walls built of tabby, the circumference of which is about eight miles. On these walls there are no guns mounted; but they are flanked with square towers, and surrounded by a wide and deep ditch. The city has a number of entrances, consisting of large double porches of tabby in the Gothic style, the gates of which are regularly shut every night at certain hours. As polygamy is allowed by the Mahometan religion, and is supposed in some degree to affect population, it would be difficult to form any computation near the truth with respect to the number of inhabitants which this city may contain. The mosques, which are the only public buildings except the palace worth noticing at Morocco, are more numerous than magnificent; one of them is ornamented with a very high and square tower, built of cut stone, which is visible at a considerable distance from the city. The streets are very narrow, dirty, and irregular, and many of the houses are uninhabited and falling to ruin. Those which are decent and respectable in their appearance are built of tabby, and enclosed in gardens. That of the effendi or prime minister (according to Mr Lempriere, from whose *Tour** this account is transcribed), was among the best in Morocco. This house, which consisted of two stories, had elegant apartments both above and below, furnished in a style far superior to any thing our author ever saw in that country. The court, into which the lower apartments opened, was very neatly paved with glazed blue and white tiling, and had in its centre a beautiful fountain. The upper apartments were connected together by a broad gallery, the balusters of which were painted of different colours. The hot and cold baths were very large, and had every convenience which art could afford. Into the garden, which was laid out in a tolerably neat style, opened a room adjoining to the house, which had a broad arched entrance but no door, beautifully ornamented with chequered tiling; and at both ends of the apartment the walls were entirely covered with looking glass. The flooring of all the rooms was covered with beautiful carpeting, the walls ornamented with large and valuable looking glasses, intermixed with watches and clocks in glass cases. The ceiling was carved woodwork, painted of different colours; and the whole was in a superior style of Moorish grandeur. This and a few others are the only decent habitations in Morocco. The generality of them serve only to impress the traveller with the idea of a miserable and deserted city.

Morocco.

* Published in 1792.

The Elcaisseria is a particular part of the town where stuffs and other valuable articles are exposed to sale. It consists of a number of small shops, formed in the walls of the houses, about a yard from the ground, of such a height within as just to admit a man to sit in one of them cross-legged. The goods and drawers are so arranged round him, that when he serves his customers, who are standing all the time out in the street, he can reach down any article he wants without being under the necessity of moving. These shops, which are found in all the other towns of the empire, are sufficient to afford a striking example of the indolence of the Moors. There are three daily markets in different parts of the town of Morocco where provisions are sold, and two weekly fairs or markets for the disposal of cattle. The city is supplied with water by means of wooden pipes connected with the neighbouring streams, which empty themselves into reservoirs placed for the purpose in the suburbs, and some few in the centre of the town.

The castle is a large and ruinous building, the outer walls

Morocco. walls of which enclose a space of ground about three miles in circumference. It has a mosque, on the top of which are three large balls, formed, as the Moors allege, of solid gold. The castle is almost a town of itself; it contains a number of inhabitants, who in some department or other are in the service of the emperor, and all under the direction of a particular alcaide, who is quite independent of the governor of the town. On the outside of the castle, between the Moorish town and the Jewdry, are several small distinct pavilions, enclosed in gardens of orange trees, which are intended as occasional places of residence for such of the emperor's sons or brothers as happen to be at Morocco. As they are covered with coloured tiling, they have at a small distance rather a neat appearance; but upon approaching or entering them, that effect in a great measure ceases.

The Jews, who are at this place pretty numerous, have a separate town to themselves, walled in, and under the charge of an alcaide, appointed by the emperor. It has two large gates, which are regularly shut every evening about nine o'clock; after which time no person whatever is permitted to enter or go out of the Jewdry till they are opened again the following morning. The Jews have a market of their own; and when they enter the Moorish town, castle, or palace, they are always compelled to be barefooted.

The palace is an ancient building, surrounded by a square wall, the height of which nearly excludes from the view of the spectator the other buildings. Its principal gates are constructed with Gothic arches, composed of cut stone, which conduct to several open and spacious courts; through these it is necessary to pass before we reach any of the buildings. These open courts were used by the late emperor for the purposes of transacting public business and exercising his troops. The habitable part consists of several irregular square pavilions, built of tabby, and whitened over; some of which communicate with each other, others are distinct, and most of them receive their names from the different towns of the empire. The principal pavilion is named by the Moors the *Douhar*, and is more properly the palace or seraglio than any of the others. It consists of the emperor's place of residence and the harem, forming altogether a building of considerable extent. The other pavilions are merely for the purposes of pleasure or business, and are quite distinct from the douhar. The *Mogodore* pavilion, so named from the late emperor's partiality to that town, has by far the fairest claim to grandeur and magnificence. This apartment was the work of Sidi Mahomet, and is lofty and square. It is built of cut stone, handsomely ornamented with windows, and covered with varnished tiles of various colours; and its elegance and neatness, contrasted altogether with the simplicity and irregularity of the other buildings, produce a most striking effect. In the inside, besides several other apartments, we find in the pavilion a spacious room floored with blue and white chequered tiling, its ceiling covered with curiously carved and painted wood, and its stuccoed walls variously ornamented with looking glasses and watches, regularly disposed in glass cases. To this pavilion the late emperor manifested an exclusive preference, frequently retiring to it both for the purpose of business and of recreation. The apartments of the emperor have in general a much smaller complement of furniture than those of the Moors in the inferior walks of life. Handsome carpeting, a mattress on the ground covered with fine linen, a couch, and a couple of European bedsteads, are the principal articles they contain. The gardens within the walls of the palace, of which he has several, are very neat; they contain orange and olive trees, variously disposed and arranged, and intersected with streams of water, fountains, and reservoirs. Those on the outside are nothing more than large tracts of ground, irregularly planted with olives; having four square walks, and surrounded by walls. Morocco || Morpheus.

MOROCCO, or *Marroquin*, the skin of a goat, or some other animal resembling it, dressed in sumach or galls, and coloured at pleasure; much used in bookbinding, &c. The name is commonly derived from the kingdom of Morocco, whence it is supposed the manner of preparing these skins was first borrowed. We have Morocco skins brought from the Levant, Barbary, Spain, Flanders, and France; red, black, yellow, blue, &c. For the manner of preparing them see LEATHER.

MORON, a town of Spain, in Andalusia, seated in a fertile plain about 30 miles south-east of Seville. W. Long. 5. 20. N. Lat. 37. 0.

MORPETH, a handsome town of Northumberland, 14 miles from Newcastle, 286 miles from London, is an ancient borough by prescription, with a bridge over the Wansbeck. It had once an abbey and a castle, now in ruins, situated about a quarter of a mile south of the town and river Wansbeck, on an eminence which overlooks both. The market-place is conveniently situated near the centre of the town; and an elegant townhouse was built by the Carlisle family in 1714, in which the quarter-sessions is held for the county. It is built of hewn stone, with a piazza. The church being a quarter of a mile distant from the town, a tower containing a good ring of bells stands near the market place. Near the bridge is the county gaol, a modern structure. Here are a free grammar school, a chapel near the river, on the site of a chantry that was granted for the support of the foundation of the school, which was part of the old structure, and an hospital for infirm people. In 1215, the townsmen themselves burnt their town, out of pure hatred to King John, that he might find no shelter there. Here is a good market on Saturday for corn, cattle, and all necessary provisions; and there is another on Wednesday, the greatest in England except Smithfield, for live cattle. This is a post town and a thoroughfare, with many good inns, and plenty of fish; and here are several mills.—The earl of Carlisle's steward holds a court here twice a-year, one of them the Monday after Michaelmas, when four persons are chosen by the free burgesses, who are about 107, and presented to the steward, who names two of them to the bailiffs, who, with seven aldermen, are its governors for the year ensuing. In 1811 the inhabitants amounted to nearly 3244. It has several fairs, and sends two members to parliament. W. Long. 1. 24. N. Lat. 55. 12.

MORPHEUS, in fabulous history, the god of sleep, or, according to others, one of the ministers of Somnus. He caused sleepiness, and represented the forms

Morpheus || Mortality.

forms of dreams. Ovid styles him the kindest of the deities; and he is usually described in a recumbent posture, and crowned with poppies.

MORRERI, Lewis, author of the Historical Dictionary, was born at Barge-mont in Provence, in 1643. He learned rhetoric and philosophy at Aix, and divinity at Lyons. At 18 years of age he wrote a small piece, entitled *Le Pays d'Amour*, and a collection of the finest French poems entitled *Doux plaisirs de la Poesie*. He learned Spanish and Italian; and translated out of Spanish into French the book entitled *La Perfection Chretienne de Rodriguez*. He then refined the Saints Lives to the purity of the French tongue. Being ordained priest, he preached at Lyons, and undertook, when he was but 30 years of age, a new Historical Dictionary, printed at Lyons in one vol. folio, 1673. But his continual labour impaired his health; so that he died in 1680, aged 37. His second volume was published after his death; and four more volumes have since been added. He left some other works behind him.

MORRHINA or Murrhina vasa, were a sort of cups or vases made use of by the ancients for drinking out of, and other purposes. Authors are not agreed as to the substance of which they were made. Some say it was a stone; some assert that it was a fluid condensed by being buried under ground. All that we know concerning it is, that it was known by the name of *murrha*, and that Heliogabalus's chamber pot was made of it. The word is sometimes written *myrrhina*.

MORRISE-dances. See *Moresque-Dances*.

MORS, Death, one of the infernal deities, born of Night without a father. She was worshipped by the ancients with great solemnity. She was not represented as an actually existing power, but as an imaginary being. Euripides introduces her in one of his tragedies on the stage. The moderns represent her as a skeleton armed with a scythe and a scimeter.

MORSE. See Trichecus, Mammalia *Index*.

MORTALITY, a term frequently used to signify a contagious disease, which destroys great numbers of either men or beasts.

Bills of Mortality, are accounts or registers specifying the numbers born, married, and buried in any parish, town, or district. In general they contain only these numbers; and, even when thus limited, are of great use, by showing the degrees of healthiness and prolificknes, and the progress of population in the places where they are kept. It is therefore much to be wished, that such accounts had been always correctly kept in every kingdom, and regularly published at the end of every year. We should then have had under our inspection the comparative strength of every kingdom, as far as it depends on the number of inhabitants, and its increase or decrease at different periods. But such accounts are rendered more useful, when they include the ages of the dead, and the distempers of which they have died. In this case they convey some of the most important instructions, by furnishing us with the means of ascertaining the law which governs the waste of human life, the values of annuities dependent on the continuance of any lives, or any survivorships between them, and the favourableness and unfavourableness of different situations to the duration of human life. There are but few registers of this kind; nor has this subject, though so interesting to mankind, ever engaged much attention till lately. The first bills containing the ages of the dead were those for the town of Breslaw in Silesia. It is well known what use has been made of these by Dr Halley, and after him by De Moivre. A table of the probabilities of the duration of human life at every age, deduced from them by Dr Halley, has been published in the Philosophical Transactions, (see the Abridgement, vol. iii. p. 699.) and is the first table of that sort that has been ever published. Since the publication of this table similar bills have been established in a few towns of this kingdom; and particularly in London, in the year 1728, and at Northampton in 1735. Mortality.

Two improvements of these registers have been proposed: the first is, That the sexes of all that die in every period of life should be specified in them, under the denomination of *boys*, *married men*, *widowers*, and *bachelors*; and of *girls*, *married women*, *widows*, and *virgins*. The second is, That they should specify the number of both sexes dying of every distemper in every month, and at every age. See the end of the 4th essay in Dr Price's Treatise on Reversionary Payments. Registers of mortality thus improved, when compared with records of the seasons, and with the circumstances that discriminate different situations, might contribute greatly to the increase of medical knowledge; and they would afford the necessary data for determining the difference between the duration of human life among males and females; for such a difference there certainly is much in favour of females, as will appear from the following facts.

At Northampton, though more males are born than females: and nearly the same number die; yet the number of living females appeared, by an account taken in 1746, to be greater than the number of males, in the proportion of 2301 to 1770, or 39 to 30.

At Berlin it appeared, from an accurate account which was taken of the inhabitants in 1747, that the number of female citizens exceeded the number of male citizens in the proportion of 459 to 391. And yet out of this smaller number of males, more had died for 20 years preceding 1751, in the proportion of 19 to 17.

At Edinburgh, in 1743, the number of females was to the number of males as 4 to 3. (See Maitland's History of Edinburgh, p. 220). But the females that died annually from 1749 to 1758, were to the males in no higher proportion than $3\frac{1}{5}$ to 3.

He that will take the pains to examine the accounts in Phil. Trans. Abr. vol. vii. part iv. p. 46, &c. will find, that though in the towns there enumerated, the proportion of males and females born is no higher than 19 to 18, yet the proportion of boys and girls that die is 8 to 7; and that, in particular, the still-born and chrysom males are to the still-born and chrysom females as 3 to 2.

In 39 parishes of the district of Vaud in Switzerland, the number of males that died during ten years before 1766 was 8170; of females 8167; of whom the numbers that died under one year of age were 1817 males and 1305 females; and under ten years of age, 3099 males and 2598 females. In the beginning of life, therefore, and before any emigrations can take place, the rate of mortality among males appears to

be

Mortality. be greater than among females. And this is rendered yet more certain by the following accounts. At Vevey, in the district of Vaud just mentioned, there died in the course of 20 years, ending at 1764, in the first month after birth, of males 135 to 89 females; and in the first year 225 to 162. To the same effect it appears from a table given by Susmilch, in his Gottliche Ordnung, vol. ii. p. 317, that in Berlin 203 males die in the first month, and but 168 females; and in the first year, 489 to 395; and also, from a table of Struyck's, that in Holland 396 males die in the first year to 306 females.

The authorities for the facts here mentioned, and much more on this subject, may be found in the 4th essay in Dr Price's Treatise on Reversionary Payments, and in the supplement at the end of that treatise.

We shall here only add the following table, taken from a memoir of Mr Wargentin's, published in the collection of the Memoirs of the Royal Academy of Sciences at Stockholm, printed at Paris in 1772.

In all Sweden for nine years, ending in 1763, the proportion of females to males that died out of a given number living, was

Under the age of one year,			1000 to 1099
From 1 to 3 years of age,			1000—1022
3—	—5	—	1042
5—	10	—	1074
10—	15	—	1080
15—	20	—	1097
20—	25	—	1283
25—	30	—	1161
30—	35	—	993
35—	40	—	1159
40—	45	—	1115
45—	50	—	1340
50—	55	—	1339
55—	60	—	1292
60—	65	—	1115
65—	70	—	1080
70—	80	—	1022
80—	90	—	1046
Above 90		—	1044

Registers of mortality on the improved plan before mentioned, were established in 1772 at Chester, and also in 1773 at Warrington in Lancashire; and they are so comprehensive and correct, that there is reason to expect they will afford much instruction on the subject of human mortality, and the values of lives.

But the country most distinguished in this respect is Sweden: for in that kingdom exact accounts are taken of the births, marriages, and burials, and of the numbers of both sexes that die at all ages in every town and district, and also at the end of every period of five years, of the numbers living at every age: and at Stockholm a society is established, whose business it is to superintend and regulate the enumerations, and to collect from the different parts of the kingdom the registers, in order to digest them into tables of observation. These regulations were begun in Sweden in 1755; and tables, containing the result of them from 1755 to 1763, have been published in Mr Wargentin's memoir just referred to; and the most material parts of them may be found in an essay by Dr Price on the Difference between the Duration of Human Life in Towns and in Country Parishes, printed in the 65th volume of the Philosoph. Trans. Part II. Mortality.

In the fourth essay in Dr Price's Treatise on Reversionary Payments and Life Annuities, the following account is given of the principles on which tables of observation are formed from registers of mortality; and of the proper method of forming them, so as to render them just representations of the number of inhabitants, and the probabilities of the duration of human life in a town or country.

In every place which just supports itself in the number of its inhabitants, without any recruits from other places; or where, for a course of years, there has been no increase or decrease; the number of persons dying every year at any particular age, and above it, must be equal to the number of the living at that age. The number, for example, dying every year at all ages from the beginning to the utmost extremity of life, must, in such a situation, be just equal to the whole number born every year. And for the same reason, the number dying every year at one year of age and upwards, at two years of age and upwards, at three and upwards, and so on, must be equal to the numbers that attain to those ages every year; or, which is the same, to the numbers of the living at those ages. It is obvious, that unless this happens, the number of inhabitants cannot remain the same. If the former number is greater than the latter, the inhabitants must decrease; if less, they must increase. From this observation it follows, that in a town or country where there is no increase or decrease, bills of mortality which give the ages at which all die, will show the exact number of inhabitants, and also the exact law according to which human life wastes in that town or country.

In order to find the number of inhabitants, the mean numbers dying annually at every particular age and upwards must be taken as given by the bills, and placed under one another in the order of the second column of the following tables. These numbers will, it has appeared, be the numbers of the living at 1, 2, 3, &c. years of age; and consequently the sum diminished by half the number born annually will be the whole number of inhabitants.

This subtraction is necessary, for the following reason. In a table formed in the manner here directed, it is supposed that the numbers in the second column are all living together at the beginning of every year. Thus the number in the second column opposite to 0 in the first column, the table supposes to be all just born together on the first day of the year. The number, likewise, opposite to 1, it supposes to attain to one year of age just at the same time that the former number is born. And the like is true of every number in the second column. During the course of the year, as many will die at all ages as were born at the beginning of the year, and consequently, there will be an excess of the number alive at the beginning of the year above the number alive at the end of the year, equal to the whole number of the annual births; and the true number constantly alive together, is the arithmetical mean between these two numbers, or a-

Mortality. greeably to the rule here given, the sum of the numbers in the second column of the table lessened by half the number of annual births.

In such a series of numbers, the excess of each number above that which immediately follows it will be the number dying every year out of the particular number alive at the beginning of the year; and these exeesses set down regularly as in the third column of the table to which we have referred, will show the different rates at which human life wastes through all its different periods, and the different probabilities of life at all particular ages.

It must be remembered, that what has been now said goes on the supposition, that the place whose bills of mortality are given, supports itself, by procreation only, in the number of its inhabitants. In towns this very seldom happens, on account of the luxury and debauchery which generally prevail in them. They are, therefore, commonly kept up by a constant accession of strangers, who remove to them from country parishes and villages. In these circumstances, in order to find the true number of inhabitants, and probabilities of life, from bills of mortality containing an account of the ages at which all die, it is necessary that the proportion of the annual births to the annual settlers should be known, and also the period of life at which the latter remove. Both these particulars may be discovered in the following method.

If for a course of years there have been no sensible increase or decrease in a place, the number of annual settlers will be equal to the excess of the annual burials above the annual births. If there be an increase, it will be greater than this excess. If there be a decrease, it will be less.

The period of life at which these settlers remove, will appear in the bills by an increase in the number of deaths at that period and beyond it. Thus in the London bills the number of deaths between 20 and 30 is generally above double, and between 30 and 40 near triple the number of deaths between 10 and 20; and the true account of this is, that from the age of 18 or 20 to 35 or 40, there is an afflux of people every year to London from the country, which occasions a great increase in the number of inhabitants at these ages; and consequently raises the deaths for all ages above 20 considerably above their due proportion when compared with the number of deaths before 20. This is observable in all the bills of mortality for towns with which we are acquainted, not even excepting the Breslaw bills. Dr Halley takes notice, that these bills gave the number of deaths between 10 and 20 too small. This he considered as an irregularity in them owing to chance; and, therefore, in forming his table of observations, he took the liberty so far to correct it, as to render the proportion of those who die to the living in this division of life nearly the same with the proportion which, he says, he had been informed die annually of the young lads in Christ Church hospital. But the truth is, that this irregularity in the bills was derived from the cause we have just assigned. During the five years for which the Breslaw bills are given by Dr Halley, the births did indeed a little exceed the burials; but it appears that this was the effect of some peculiar causes that happened to operate just at that time; for during a complete century, from 1633 to 1734, the annual medium of births was 1089, and of burials 1256. This town, therefore, must have been all along kept up by a number of yearly recruits from other places, equal to about a seventh part of the yearly births. Mortality.

It appears from the account in the Philosophical Transactions (Abridgement, vol. vii. N° 332, p. 46, &c.), that from 1717 to 1725, the annual medium of births at Breslaw was 1252, of burials 1507; and also that much the greatest part of the births died under 10 years of age. From a table in Susmilch's works, vol. i. p. 38, it appears that in reality the greater part of all that die in this town are children under five years of age.

What has been now observed concerning the period of life at which people remove from the country to settle in towns, would appear sufficiently probable were there no such evidence for it as has been mentioned; for it might well be reckoned that these people in general must be single persons in the beginning of mature life, who not having yet obtained settlements in the places where they were born, migrate to towns in quest of employments.

Having premised these observations, it will be proper next to endeavour to explain distinctly the effect which these accessions to towns must have on tables of observation formed from their bills of mortality. This is a subject proper to be insisted on, because mistakes have been committed about it; and because also the discussion of it is necessary to show how near to truth the value of lives comes as deduced from such tables.

The following general rule may be given on this subject. If a place has for a course of years been maintained in a state nearly stationary, as to number of inhabitants, by recruits coming in every year, to prevent the decrease that would arise from the excess of burials above the births, a table formed on the principle, "that the number dying annually after every particular age, is equal to the number living at that age," will give the number of inhabitants, and the probabilities of life, too great, for all ages, preceding that at which the recruits cease: and after this it will give them right. If the accessions are so great as to cause an increase in the place, such a table will give the number of inhabitants and the probabilities of life too little after the age at which the accessions cease; and too great if there is a decrease. Before that age it will in both cases give them too great; but most considerably so in the former case, or when there is an increase.

Agreeably to these observations, if a place increases not in consequence of accessions from other places, but of a constant excess of the births above the deaths, a table constructed on the principle that has been mentioned will give the probabilities of life too low through the whole extent of life; because in such circumstances the number of deaths in the first stages of life must be too great in comparison of the number of deaths in the latter stages; and more or less so as the increase is more or less rapid. The contrary in all respects takes place where there is a decrease arising from the excess of the deaths above the births.

For example: Let us suppose that 244 of those born in a town attain annually to 20 years of age, and

Mortality. and that 250 more, all likewise 20 years of age, come into it annually from other places, in consequence of which it has for a course of years been just maintained in the number of its inhabitants, without any sensible increase or decrease: in these circumstances, the number of the living in the town of the age of 20 will be always 244 natives, and 250 settlers, or 494 in all; and since these are supposed all to die in the town, and no more recruits are supposed to come in, 494 will be likewise the number dying annually at 20 and upwards. In the same manner it will appear, on these suppositions, that the number of the living at every age subsequent to 20 will be equal to the number dying annually at that age and above it; and consequently that the number of inhabitants and the decrements of life, for every such age, will be given exactly by the table. But for all ages before 20, they will be given much too great. For let 280 of all born in the town reach 10; in this case, 280 will be the true number of the living in the town at the age of 10; and the recruits not coming in till 20, the number given by the bills as dying between 10 and 20 will be the true number dying annually of the living in this division of life. Let this number be 36; and it will follow that the table ought to make the numbers of the living at the ages between 10 and 20, a series of decreasing means between 280 and (280 diminished by 36, or) 244. But in forming the table on the principle just mentioned, 250 (the number above 20 dying annually in the town who were not born in it) will be added to each number in this series; and therefore the table will give the numbers of the living, and the probabilities of life in this division of life, almost twice as great as they really are. This observation, it is manifest, may be applied to all the ages under 20.

It is necessary to add, that such a table will give the number of inhabitants and the probabilities of life equally wrong before 20, whether the recruits all come in at 20, agreeably to the supposition just made, or only begin then to come in. In this last case, the table will give the number of inhabitants and probabilities of life too great throughout the whole extent of life, if the recruits come in at all ages above 20. But if they cease at any particular age, it will give them right only from that age; and before, it will err all along on the side of excess; but less considerably between 20 and that age than before 20. For example: if, of the 250 supposed to come in at 20, only 150 then come in, and the rest at 30; the number of the living will be given 100 too high at every age between 20 and 30; but, as just shown, they will be given 250 too high at every age before 20. In general, therefore, the number of the living at any particular age must be given by the supposed table as many too great as there are annual settlers after that age; and if these settlers come in at all ages indiscriminately, during any certain interval of life, the number of inhabitants and the probabilities of life will be continually growing less and less wrong, the nearer any age is to the end of that interval. These observations prove, that tables of observation formed in the common way, from bills of mortality for places where there is an excess of the burials above the births, must be erroneous for a great part of the duration of life, in proportion to the degree of that excess. They show likewise at what parts of life the errors in such tables are most considerable, and how they may be in a great measure corrected. Mortality.

All this shall be exemplified in the particular case of London.

The number of deaths between the ages of 10 and 20 is always so small in the London bills, that it seems certain few recruits come to London under 20, or at least not so many as before this age are sent out for education to schools and universities. After 20 great numbers come in till 30, and some perhaps till 40 or 50: but at every age after 50, it is probable that more retire from London than come to it. The London tables of observation, therefore, being formed on the principle already mentioned, cannot give the probabilities of life right till 40. Between 30 and 40 they must be a little too high; but more so between 20 and 30, and most of all so before 20. It follows also that these tables must give the number of inhabitants in London much too great.

The first of the following tables is formed in the manner here explained, from the London bills for 10 years, from 1759 to 1768, and adapted to 1000 born as a radix. The sum of the numbers in the second column, diminished by half the number born, is 25.757. According to this table, then, for every 1000 deaths in London there are $25\frac{3}{4}$ as many inhabitants; or, in other words, the expectation of a child just born is $25\frac{3}{4}$; and the inhabitants are to the annual burials as $25\frac{3}{4}$ to 1. But it has appeared, that the numbers in the second column, being given on the supposition that all those who die in London were born there, must be too great; and we have from hence a demonstration, that the probabilities of life are given in the common tables of London observations too high for at least the first 30 years of life; and also, that the number of inhabitants in London must be less that $25\frac{3}{4}$ multiplied by the annual burials. The common tables, therefore, of London observations undoubtedly need correction, as Mr Simpson suggested, and in some measure performed; though too imperfectly, and without going upon any fixed principles, or showing particularly how tables of observation ought to be formed, and how far in different circumstances, and in different ages, they are to be depended on. The way of doing this, and in general the right method of forming genuine tables of observation for towns, may be learned from the following rule:

"From the sum of all that die annually, after any given age, subtract the number of annual settlers after that age; and the remainder will be the number of the living at the given time."

This rule can want no explication or proof after what has been already said.

If, therefore, the number of annual settlers in a town at every age could be ascertained, a perfect table of observations might be formed for that town from bills of mortality, containing an account of the ages at which all die in it. But no more can be learned in this instance from any bills, than the whole number of annual settlers, and the general division of life in which they enter. This, however, may be sufficient to enable us to form tables that shall be tolerably exact. For instance: Suppose the annual deaths in a town which has not increased or decreased, to have

Mortality. been for many years in the proportion of 4 to 3 to the annual births. It will hence follow, that $\frac{1}{4}$ of the persons who die in such a town are settlers, or emigrants from other places, and not natives; and the sudden increase in the deaths after 20 will also show, agreeably to what was before observed, that they enter after this age. In forming, therefore, a table for such a town, a quarter of all that die at all ages throughout the whole extent of life must be deducted from the sum of all that die after every given age before 20; and the remainder will be the true number living at that given age. And if at 20, and every age above it, the deduction is omitted, or the number of the living at every such age is taken the same with the sum of all that die after it, the result will be (supposing most of the settlers to come in before 30, and all before 40) a table exact till 20; too high between 20 and 30; but nearly right for some years before 40; and after 40 exact again. Such a table, it is evident, will be the same with the table last described at all ages above 20, and different from it only under 20. It is evident also, that on account of its giving the probabilities of life too great for some years after 20, the number of inhabitants deduced from it may be depended on as somewhat greater than the truth; and more or less so, as the annual recruits enter in general later or sooner after 20.

Let us now consider what the result of these remarks will be, when applied particularly to the London bills.

It must be here first observed, that at least one quarter of all that die in London are supplies or settlers from the country, and not natives. The medium of annual burials for 10 years, from 1759 to 1768, was 22,956; of births 15,710. The excess is 7246, or near a third of the burials. The same excess during 10 years before 1750 was 10,500, or near half the burials. London was then decreasing. For the last 12 or 15 years it has been increasing. This excess, therefore, agreeably to the foregoing observations, was then greater than the number of annual settlers, and it is now less. It is however here supposed, that the number of annual settlers is now no more than a quarter of the annual burials, in order to allow for more omissions in the births than the burials; and also, in order to be more sure of obtaining results that shall not exceed the truth.

Of every 1000 then who die in London only 750 are natives, and 250 are recruits who come to it after 18 or 20 years of age; and, consequently, in order to obtain from the bills a more correct table than the first of the following tables, 250 must be subtracted from every one of the numbers in the second column till 20; and the numbers in the third column must be kept the same, the bills always giving these right. After 20, the table is to be continued unaltered; and the result will be, a table which will give the numbers of the living at all ages in London much nearer the truth but still somewhat too high. Such is the second of the following tables. The sum of all the numbers in the second column of this table, diminished by 500, is 20,750. For every 1000 deaths, therefore, in London, there are, according to this table, 20,750 living persons in it; or for every single death $20\frac{3}{4}$ inhabitants. It was before shown, that the number of inhabitants in London could not be so great as $25\frac{3}{4}$ times the deaths. It now appears (since the numbers in the second column of this table are too high) that the number of inhabitants of London cannot be so great as even $20\frac{3}{4}$ times the deaths. And this is a conclusion which every one, who will bestow due attention on what has been said, will find himself forced to receive. It will not be amiss, however, to confirm it by the following fact, the knowledge of which is derived from the particular inquiry and information of Mr Harris, the late ingenious master of the royal mathematical school in Christ-Church hospital. The average of lads in this school has, for 30 years past, been 831. They are admitted at all ages between 7 and 11; and few stay beyond 16: they are, therefore, in general, lads between the age of 8 and 16. They have better accommodations than it can be supposed children commonly have; and about 300 of them have the particular advantage of being educated in the country. In such circumstances it may be well reckoned, that the proportion of children dying annually must be less than the general proportion of children dying annually at the same ages in London. The fact is, that for the last 30 years $11\frac{4}{5}$ have died annually, or one in $70\frac{1}{3}$. Mortality.

According to Table II. one in 73 dies between 10 and 20, and one in 70 between 8 and 16. That table, therefore, probably gives the decrements of life in London at these ages, too little, and the numbers of the living too great: and if this is true of these ages, it must be true of all other ages under 20; and it follows demonstrably, in conformity to what was before shown, that more people settle in London after 20 than the fourth above supposed; and that from 20 to at least 30 or 35, the numbers of the living are given too great, in proportion to the decrements of life.

In this table the numbers in the second column are doubled at 20, agreeably to what really happens in London; and the sum of the numbers in this column, diminished by half the whole number of deaths, gives the expectation of life, not of a child just born, as in other tables, but of all the inhabitants of London at the time they enter it, whether that be at birth or at 20 years of age. The *expectations*, therefore, and the *values* of London lives under 20, cannot be calculated from this table. But it may be very easily fitted for this purpose, by finding the number of births which, according to the given decrements of life, will leave 494 alive at 20; and then adapting the intermediate numbers in such a manner to this radix, as to preserve all along the number of the living in the same proportion to the numbers of the dead. This is done in the third of the following tables; and this table may be recommended as better adapted to the present state of London than any other table. The values of lives, however, deduced from it, are in general nearly the same with those deduced by Mr Simpson from the London bills as they stood forty years ago; the main difference is, that after 52, and in old age, this table gives them somewhat lower than Mr Simpson's table. The fourth and fifth of the following tables, compared with the two last, will give a distinct and full view of the difference between the rate of human mortality in great towns and in country parishes and villages.

TABLE

Mortality.

TABLE I.

Showing the Probabilities of Life in London, on the supposition that all who die in London were born there. Formed from the Bills for 10 years, from 1759 to 1768.

Ages	Persons living.	Decr. of Life	Ages.	Persons living.	Decr. of Life	Ages.	Persons living.	Decr of Life
0	1000	240	31	404	9	62	132	7
1	760	99	32	395	9	63	125	7
2	661	42	33	386	9	64	118	7
3	619	29	34	377	9	65	111	7
4	590	21	35	368	9	66	104	7
5	569	11	36	359	9	67	97	7
6	558	10	37	350	9	68	90	7
7	548	7	38	341	9	69	83	7
8	541	6	39	332	10	70	76	6
9	535	5	40	322	10	71	70	6
10	530	4	41	312	10	72	64	6
11	526	4	42	302	10	73	58	5
12	522	4	43	292	10	74	53	5
13	518	3	44	282	10	75	48	5
14	515	3	45	272	10	76	43	5
15	512	3	46	262	10	77	38	5
16	509	3	47	252	10	78	33	4
17	506	3	48	242	9	79	29	4
18	503	4	49	233	9	80	25	3
19	499	5	50	224	9	81	22	3
20	494	7	51	215	9	82	19	3
21	487	8	52	206	8	83	16	3
22	479	8	53	198	8	84	13	2
23	471	8	54	190	7	85	11	2
24	463	8	55	183	7	86	9	2
25	455	8	56	176	7	87	7	2
26	447	8	57	169	7	88	5	1
27	439	8	58	162	7	89	4	1
28	431	9	59	155	8	90	3	1
29	422	9	60	147	8			
30	413	9	61	139	7			

TABLE II.

Showing the true probabilities of Life in London till the age of 19.

Ages	Persons living.	Decr of Life	Ages.	Persons living.	Decr of Life	Ages	Person living.	Decr of Life
0	750	240	9	285	5	18	253	4
1	510	99	10	280	4	19	249	
2	411	42	11	276	4	20	494	
3	369	29	12	272	4	21	487	
4	340	21	13	268	3	&c.	&c.	
5	319	11	14	265	3			
6	308	10	15	262	3			
7	298	7	16	259	3			
8	291	6	17	256	3			

The numbers in the second column to be continued as in the last table

Mortality.

TABLE III.

Showing the true Probabilities of Life in London for all ages. Formed from the Bills for 10 years, from 1759 to 1768.

Ages	Persons living.	Decr of Life	Ages.	Persons living.	Decr of Life	Ages.	Persons living.	Decr of Life
0	1518	486	31	404	9	62	132	7
1	1032	200	32	395	9	63	125	7
2	832	85	33	386	9	64	118	7
3	747	59	34	377	9	65	111	7
4	688	42	35	368	9	66	104	7
5	646	23	36	359	9	67	97	7
6	623	20	37	350	9	68	90	7
7	603	14	38	341	9	69	83	7
8	589	12	39	332	10	70	76	6
9	577	10	40	322	10	71	70	6
10	567	9	41	312	10	72	64	6
11	558	9	42	302	10	73	58	5
12	549	8	43	292	10	74	53	5
13	541	7	44	282	10	75	48	5
14	534	6	45	272	10	76	43	5
15	528	6	46	262	10	77	38	5
16	522	7	47	252	10	78	33	4
17	515	7	48	242	9	79	29	4
18	508	7	49	233	9	80	25	3
19	501	7	50	224	9	81	22	3
20	494	7	51	215	9	82	19	3
21	487	8	52	206	8	83	16	3
22	479	8	53	198	8	84	13	2
23	471	8	54	190	7	85	11	2
24	463	8	55	183	7	86	9	2
25	455	8	56	176	7	87	7	2
26	447	8	57	169	7	88	5	1
27	439	8	58	162	7	89	4	1
28	431	9	59	155	8	90	3	1
29	422	9	60	147	8			
30	413	9	61	139	7			

All the bills, from which the following tables are formed, give the numbers dying under 1 as well as under 2 years; and in the numbers dying under 1 are included, in the country parish in Brandenburg and at Berlin, all the stillborns. All the bills also give the numbers dying in every period of five years.

For the probabilities of life at Carlisle, see ANNUITIES, SUPPLEMENT.

TABLE

Mortality.

TABLE IV.

Showing the Probabilities of Life in the District of Vaud, Switzerland, formed from the Registers of 43 Parishes, given by Mr Muret, in the First Part of the Bern Memoirs for the Year 1766.

Age.	Living	Decr	Age.	Living	Decr	Age	Living	Decr.
0	1000	189	31	558	5	62	286	12
1	811	46	32	553	5	63	274	12
2	765	30	33	548	4	64	262	12
3	735	20	34	544	5			
4	715	14				65	250	14
			35	539	6	66	236	15
5	701	13	36	533	6	67	220	18
6	688	11	37	527	7	68	202	18
7	677	10	38	520	7	69	184	6
8	667	8	39	513	7			
9	659	6				70	168	15
			40	506	6	71	153	13
10	653	5	41	500	6	72	140	11
11	648	5	42	494	6	73	129	10
12	643	4	43	448	6	74	119	10
13	639	4	44	482	6			
14	635	4				75	109	11
			45	476	7	76	98	13
15	631	5	46	469	8	77	85	14
16	626	4	47	461	10	78	71	13
17	622	4	48	451	10	79	58	12
18	618	4	49	441	10			
19	614	4				80	46	10
			50	431	9	81	36	7
20	610	4	51	422	8	82	29	5
21	606	4	52	414	8	83	24	4
22	602	5	53	406	9	84	20	3
23	597	5	54	397	9			
24	592	5				85	17	3
			55	388	11	86	14	3
25	587	5	56	377	13	87	11	2
26	582	5	57	364	16	88	9	2
27	577	5	58	348	17	89	7	2
28	572	5	59	331	17			
29	567	4				90	5	1
			60	314	15			
30	563	5	61	299	13			

TABLE V.

Showing the Probabilities of Life in a Country Parish in Brandenburg, formed from the Bills for 50 Years, from 1710 to 1759, as given by Mr Susmilch, in his Gottliche Ordnung.

Age	Living	De	Age	Living	De	Age	Living.	Decr.
0	1000	225	31	482	5	62	260	12
1	775	57	32	477	5	63	248	12
2	718	31	33	472	5	64	236	12
3	687	23	34	467	5			
4	664	22				65	224	11
			35	462	6	66	213	11
5	642	20	36	456	6	67	202	12
6	622	15	37	450	6	68	190	12
7	607	12	38	444	6	69	178	12
8	595	10	39	438	6			
9	585	8				70	166	13
			40	432	5	71	153	15
10	577	7	41	427	5	72	138	16
11	570	6	42	422	5	73	122	15
12	564	5	43	417	5	74	107	14
13	559	5	44	412	6			
14	554	5				75	93	13
			45	407	6	76	80	12
15	549	5	46	400	6	77	68	9
16	544	5	47	394	6	78	59	8
17	539	4	48	388	7	79	51	7
18	535	4	49	381	7			
19	531	4				80	44	6
			50	374	7	81	38	6
20	527	5	51	367	8	82	32	6
21	522	5	52	359	8	83	25	6
22	517	5	53	351	8	84	21	5
23	512	5	54	343	9			
24	507	5				85	15	4
			55	334	10	86	11	3
25	502	4	56	324	10	87	8	2
26	498	3	57	314	10	88	6	2
27	495	3	58	304	11	89	4	1
28	492	3	59	293	11			
29	489	3				90	3	1
			60	282	11	91	2	1
30	486	4	61	271	11	92	1	1

Mortality || Mortar.

TABLE VI.

Showing the Probabilities of Life at Vienna, formed from the Bills for eight Years, as given by Mr Susmilch, in his Gottliche Ordnung, page 32, Tables.

Age.	Living	Decr.	Age.	Living	Decr.	Age.	Living	Decr.
0	1495	682	32	358	5	64	116	7
1	813	107	33	353	6			
2	706	61	34	347	7	65	109	8
3	645	46				66	101	8
4	599	33	35	340	8	67	93	8
			36	332	8	68	85	7
5	566	30	37	324	8	69	78	7
6	536	20	38	316	9			
7	516	11	39	307	9	70	71	6
8	505	9				71	65	5
9	496	7	40	298	8	72	60	5
			41	290	7	73	55	4
10	489	6	42	283	6	74	51	4
11	483	5	43	277	6			
12	478	5	44	271	7	75	47	5
13	473	6				76	42	5
14	467	6	45	264	8	77	37	5
			46	256	9	78	32	5
15	461	6	47	247	9	79	27	4
16	455	7	48	238	9			
17	448	6	49	229	9	80	23	3
18	442	6				81	20	2
19	436	6	50	220	8	82	19	2
			51	212	7	83	16	2
20	430	5	52	205	7	84	14	2
21	425	5	53	198	7			
22	420	5	54	191	7	85	12	2
23	415	6				86	10	2
24	409	6	55	184	8	87	8	2
			56	176	8	88	6	2
25	403	6	57	168	9	89	4	1
26	397	6	58	159	8			
27	391	7	59	151	8	90	3	1
28	381	7				91	2	1
29	377	7	60	143	7	92	1	1
			61	136	7			
30	370	6	62	129	6			
31	364	6	63	123	7			

Mortality || Mortar.

TABLE VII.

Showing the Probabilities of Life at Berlin, formed from the Bills for Four Years, from 1752 to 1755, given by Mr Susmilch in his Gottliche Ordnung, vol. ii. p. 37, Tables.

Age.	Living	Decr.	Age.	Living.	Decr.	Age.	Living	Decr
0	1427	524	32	368	7	64	118	6
1	903	151	33	361	7			
2	752	61	34	354	7	65	112	6
3	691	73				66	106	7
4	618	45	35	347	8	67	99	7
			36	339	8	68	92	6
5	573	21	37	330	10	69	86	6
6	552	15	38	320	10			
7	536	13	39	310	10	70	80	6
8	523	9				71	74	6
9	514	7	40	300	10	72	68	6
			41	290	9	73	62	5
10	507	5	42	281	8	74	57	5
11	502	4	43	274	7			
12	498	4	44	266	7	75	52	5
13	494	4				76	47	5
14	490	4	45	259	7	77	42	5
			46	252	7	78	37	5
15	486	4	47	245	7	79	32	4
16	482	5	48	238	7			
17	477	5	49	231	7	80	28	4
18	472	5				81	24	3
19	467	6	50	224	7	82	21	2
			51	217	7	83	19	2
20	461	6	52	210	7	84	17	2
21	455	6	53	203	8			
22	449	6	54	195	8	85	15	2
23	443	7				86	13	2
24	436	8	55	187	8	87	11	2
			56	179	8	88	9	2
25	428	9	57	171	8	89	7	1
26	421	9	58	163	9			
27	412	9	59	154	9	90	6	1
28	403	9				91	5	1
29	394	9	60	145	8	92	4	1
			61	137	7	93	3	1
30	385	9	62	130	6	94	2	1
31	376	8	63	124	6			

BRIEF *of* MORTANCESTRY, in *Scots Law*; anciently the ground of an action at the instance of an heir, in the special case where he had been excluded from the possession of his ancestor's estate by the superior, or other person pretending right.

MORTAR, a preparation of lime and sand mixed with water, which serves as a cement, and is used by masons and bricklayers in building walls of stone and brick. See LIME, CHEMISTRY *Index*.

MORTAR, a chemical utensil, very useful for the division of bodies, partly by percussion and partly by grinding. Mortars have the form of an inverted bell. The matter intended to be pounded is to be put into them, and there it is to be struck and bruised by a long instrument called a *pestle*. The motion given to the pestle ought to vary according to the nature of the substances to be pounded. Those which are easily broken, or which are apt to fly out of the mortar, or which are hardened by the stroke of the pestle, require that this instrument should be moved circularly, rather by grinding or bruising than by striking. Those substances which are softened by the heat occasioned by rubbing

Mortar. rubbing and percussion, require to be pounded very slowly. Lastly, Those which are very hard, and which are not capable of being softened, are easily pounded by repeated strokes of the pestle. They require no bruising but when they are brought to a certain degree of fineness. But these things are better learned by habit and practice than by any directions.

As mortars are instruments which are constantly used in chemistry, they ought to be kept of all sizes and materials; as of marble, copper, glass, iron, gritstone, and agate. The nature of the substance to be pounded determines the choice of the kind of mortar. The hardness and dissolving power of that substance are particularly to be attended to. As copper is a metal, which is soluble by almost all menstrua, and hurtful to health, this metal is rarely or never employed for the purpose of making mortars.

One of the principal inconveniences of pulverization in a mortar proceeds from the fine powder which rises abundantly from some substances during the operation. If these substances be precious, the loss will be considerable; and if they be injurious to health, they may hurt the operator. These inconveniences may be remedied, either by covering the mortar with a skin, in the middle of which is a hole, through which the pestle passes; or by moistening the matter with a little water when this addition does not injure it; or, lastly, by covering the mouth and nose of the operator with a fine cloth, to exclude this powder. Some substances, as corrosive sublimate, arsenic, calces of lead, cantharides, euphorbium, &c. are so noxious, that all these precautions ought to be used, particularly when a large quantity is pounded. Mortar.

Large mortars ought to be fixed upon a block of wood, so high, that the mortar shall be level with the middle of the operator. When the pestle is large and heavy, it ought to be suspended by a cord or chain fixed to a moveable pole placed horizontally above the mortar: this pole considerably relieves the operator, because its elasticity assists the raising of the pestle.

Mortar-Piece, in the military art, a short piece of ordnance, thick and wide, proper for throwing bombs, carcases, shells, stones, bags filled with grape-shot, &c. See GUNNERY, N° 50.

Land Mortars, are those used in sieges, and of late in battles, mounted on beds made of solid timber, consisting generally of four pieces, those of the royal and cohorn excepted, which are but one single block; and both mortar and bed are transported on block-carriages. There is likewise a kind of land mortars, mounted on travelling carriages, invented by Count Buckeburg, which may be elevated to any degree; whereas ours are fixed to an angle of 45 degrees, and firmly lashed with ropes. The following table shows the weight of land mortars and shells; together with the quantity of powder the chambers hold when full the weight of the shells, and powder for loading them.

Diameter of mortars.	13-inch.	10-inch.	8-inch.	5.8-inch. royal.	4 6-inch. cohorn.
	C. qr lb.	C. qr. lb.	C qr. lb.	C. qr. lb.	C qr. lb.
Mortar's weight.	25 0 0	10 2 18	4 0 20	1 1 0	0 3 0
Shell's weight.	1 2 15	0 2 25	0 1 15	0 0 12	0 0 7
	lb. oz. gr.	lb. oz gr.	lb. oz gr.	lb oz. gr	lb. oz gr.
Shell's cont. of powder.	9 4 8	4 14 12	2 3 8	1 1 8	0 8 0
Chamber's cont. of powder.	9 1 8	4 0 0	2 0 10	1 0 0	0 8 0

Sea Mortars, are those which are fixed in bomb vessels for bombarding places by sea: and as they are generally fired at a much greater distance than that which is required by land, they are made somewhat longer and much heavier than the land mortars. The following table exhibits the weight of the sea mortars and shells, and also of their full charges.

Nature of the mortar.	Powder contained in the chamber when full.	Weight of the mortar.	Weight of the shell when fixed.	Weight of powder contained in the shell
	lb. oz.	C. qr. lb	lb.	lb. oz.
10-inch howitzer.	12 0	31 2 26		
13-inch mortar.	30 0	81 2 1	198	7 0
10-inch mortar.	12 0	34 2 11	93	

To Charge or Load a Mortar, the proper quantity of gunpowder is put into the chamber, and if there be any vacant space they fill it up with hay; some choose a wooden plug: over this they lay a turf, some a wooden tompion fitted to the bore of the piece; and lastly the bomb; taking care that the fuse be in the axis thereof, and the orifice be turned from the muzzle of the piece: what space remains is to be filled up with hay, straw, turf, &c. so as the load may not be exploded without the utmost violence.

The

Mortar. The quantity of gunpowder to be used is found by dividing the weight of the bomb by 30; though this rule is not always to be strictly observed.

When the proper quantity of powder necessary to charge a sea mortar is put into the chamber, it is covered with a wad well beat down with the rammer. After this the fixed shell is placed upon the wad, as near the middle of the mortar as possible, with the fuse hole uppermost, and another wad pressed down close upon it, so as to keep the shell firm in its position. The officer then points the mortar according to the proposed inclination.—When the mortar is thus fixed, the fuse is opened; the priming iron is also thrust into the touch-hole of the mortar to clear it, after which it is primed with the finest powder. This done, two of the matrosses or sailors, taking each one of the matches, the first lights the fuse, and the other fires the mortar. The bomb, thrown out by the explosion of the powder, is carried to the place intended: and the fuse, which ought to be exhausted at the instant of the shell's falling, inflames the powder contained in it, and bursts the shell in splinters; which, flying off circularly, occasion incredible mischief wheresoever they reach.

If the service of mortars should render it necessary to use pound shots, 200 of them with a wooden bottom are to be put into the 13 inch mortar, and a quantity of powder not exceeding 5 pounds; and 100 of the above shot with $2\frac{1}{2}$ pounds of powder, for the 10 inch mortar, or three pounds at most.

To Elevate the MORTAR so as its axis may make any given angle with the horizon, they apply the artillery level or gunner's quadrant. An elevation of 70 or 80 degrees is what is commonly chosen for rendering mortars most serviceable in casting shells into towns, forts, &c. though the greatest range be at 45 degrees.

All the English mortars are fixed to an angle of 45 degrees, and lashed strongly with ropes at that elevation. Although in a siege there is only one case in which shells should be thrown with an angle of 45 degrees; that is, when the battery is so far off that they cannot otherwise reach the works; for when shells are thrown out of the trenches into the works of a fortification, or from the town into the trenches, they should have as little elevation as possible, in order to roll along, and not bury themselves; whereby the damage they do, and the terror they occasion, are much greater than if they sink into the ground. On the contrary, when shells are thrown upon magazines or any other buildings, with an intention to destroy them, the mortars should be elevated as high as possible, that the shells may acquire a greater force in their fall, and consequently do greater execution.

If all mortar pieces were, as they ought to be, exactly similar, and their requisites of powder as the cubes of the diameters of their several bores, and if their shells, bombs, carcasses, &c. were also similar; then, comparing like with like, their ranges on the plane of the horizon, under the same degree of elevation, would be equal; and consequently one piece being well proved, i. e. the range of the grenado, bomb, carcass, &c. being found to any degree of elevation, the whole work of the mortar piece would become very easy and exact.

But since mortars are not thus similar, it is required, that the range of the piece, at some known degree of elevation, be accurately found by measuring; and from hence all the other ranges may be determined. Mortar.

Thus, to find the range of the piece at any other elevation required; say, As the sine of double the angle under which the experiment was made, is to the sine of double the angle proposed, so is the range known to the range required.

Suppose, for instance, it be found, that the range of a piece, elevated to 30°, is 2000 yards: to find the range of the same piece with the same charge when elevated to 45°; take the sine of 60°, the double of 30°, and make it the first term of the rule of three; the second term must be the sine of 90°, the double of 45°, and the third the given range 2000; the fourth term will be 2310, the range of the piece at 45°. If the elevation be greater than 45°, instead of doubling it, take the sine of double its complement to 90°. As suppose the elevation of a piece be 50°, take the sine of 80°, the double of 40°. Again, If a determinate distance to which a shot is to be cast, be given, and the angle of elevation to produce that effect be required; the range known must be the first term in the rule of three, which suppose 2000 yards; the range proposed, which we suppose 1600 yards, the second term; and the sine of 60 double of the elevation for the range of 2000 yards, the third term. The fourth term will be found the sine of 43° 52′, whose half 21° 56′ is the angle of elevation the piece must have to produce the desired effect. And if 21° 56′ be taken from 90°, you will have 68° 4′ for the other elevation of the piece, with which the same effect will likewise be produced.

Note, To avoid the trouble of finding sines of double the angles of the proposed elevations, Galileo and Torricelli give us the following table, wherein the sines of the angles sought are had by inspection.

Degrees.	Degrees	Ranges.	Degrees	Degrees	Ranges.
90	0	0	0	0	0
89	1	349	66	24	7431
88	2	698	65	25	7660
87	3	1045	64	26	7880
86	4	1392	63	27	8090
85	5	1736	62	28	8290
84	6	2079	61	29	8480
83	7	2419	60	30	8660
82	8	2756	59	31	8829
81	9	3090	58	32	8988
80	10	3420	57	33	9135
79	11	3746	56	34	9272
78	12	4067	55	35	9397
77	13	4384	54	36	9511
76	14	4695	53	37	9613
75	15	5000	52	38	9703
74	16	5299	51	39	9781
73	17	5592	50	40	9841
72	18	5870	49	41	9903
71	19	6157	48	42	9945
70	20	6428	47	43	9976
69	21	6691	46	44	9994
68	22	6947	45	45	100 0
67	23	7193			

Mortar, Mortgage.

The use of the table is obvious. Suppose, for instance, it be known by experiment, that a mortar elevated 15°, charged with three pounds of powder, will throw a bomb to the distance of 350 fathoms; and it be required, with the same charge, to throw a bomb 100 fathoms farther; seek in the table the number answering to 15 degrees, and you will find it 5000. Then as 350 is to 450, so is 5000 to a fourth number, which is 6428. Find this number, or the nearest to it, in the table, and against it you will find 20° or 70°; the proper angles of elevation.

MORTGAGE, in *Law*, (*mortuum vadium*, or dead pledge), is where a man borrows of another a specific sum (e. g. 200l.), and grants him an estate in fee, on condition that if he, the mortgager, shall pay the mortgagee the said sum of 200l. on a certain day mentioned in the deed, that then the mortgager may re-enter on the estate so granted in pledge; or, as is now the more usual way, that the mortgagee shall re-convey the estate to the mortgager: in this case the land which is so put in pledge, is by law, in case of nonpayment, at the time limited, for ever dead and gone from the mortgager; and the mortgagee's estate in the lands, is then no longer conditional, but absolute. But so long as it continues conditional, that is, between the time of lending the money and the time allotted for payment, the mortgagee is called *tenant in mortgage*. But as it was formerly a doubt, whether, by taking such estate in fee, it did not become liable to the wife's dower, and other encumbrances of the mortgage (though that doubt has been long ago overruled by our courts of equity), it therefore became usual to grant only a long term of years, by way of mortgage; with condition to be void on repayment of the mortgage money: which course has been since continued, principally because on the death of the mortgagee such term becomes vested in his personal representatives, who only are entitled in equity to receive the money lent, of whatever nature the mortgage may happen to be.

As soon as the estate is created, the mortgagee may immediately enter on the lands; but is liable to be dispossessed, upon performance of the condition by payment of the mortgage money at the day limited. And therefore the usual way is to agree that the mortgager shall hold the land till the day assigned for payment: when, in case of failure, whereby the estate becomes absolute, the mortgagee may enter upon it, and take possession, without any possibility at law of being afterwards evicted by the mortgager, to whom the land is now for ever dead. But here again the courts of equity interpose; and though a mortgage be thus forfeited, and the estate absolutely vested in the mortgagee at the common law, yet they will consider the real value of the tenements compared with the sum borrowed. And if the estate be of greater value than the sum lent thereon, they will allow the mortgager at any reasonable time to recall or redeem his estate: paying to the mortgagee his principal, interest, and expences: for otherwise, in strictness of law, an estate worth 1000l. might be forfeited for non payment of 100l. or a less sum. This reasonable advantage, allowed to mortgagers, is called the *equity of redemption*; and this enables a mortgager to call on the mortgagee, who has possession of his estate, to deliver it back, and account for the rents and profits received on payment of his whole debt and interest, thereby turning the *mortuum* into a kind of *vivum vadium*; (see VADIUM). But, on the other hand, the mortgagee may either compel the sale of the estate, in order to get the whole of his money immediately; or else call upon the mortgager to redeem his estate presently, or, in default thereof, to be for ever foreclosed from redeeming the same; that is, to lose his equity of redemption without possibility of recal. And also, in some cases of fraudulent mortgages, the fraudulent mortgager forfeits all equity of redemption whatsoever. It is not, however, usual for mortgagees to take possession of the mortgaged estate, unless where the security is precarious, or small; or where the mortgager neglects even the payment of interest: when the mortgagee is frequently obliged to bring an ejectment, and take the land into his own hands, in the nature of a pledge, or the *pignus* of the Roman law: whereas, while it remains in the hands of the mortgager, it more resembles their hypotheca, which was where the possession of the thing pledged remained with the debtor. But by statute 7 Geo. II. c. 20. after payment or tender by the mortgager of principal, interest, and costs, the mortgagee can maintain no ejectment; but may be compelled to re-assign his securities. In Glanvil's time, when the universal method of conveyance was by livery of seisin or corporal tradition of the lands, no gage or pledge of lands was good unless possession was also delivered to the creditor; *si non sequatur ipsius vadii traditio, curia domini regis hujusmodi privatas conventiones tueri non solet*: for which the reason given is, to prevent subsequent and fraudulent pledges of the same land; *cum in tali casu possit eadem res pluribus aliis creditoribus tum prius tum posterius invadiari*. And the frauds which have arisen, since the exchange of these public and notorious conveyances for more private and secret bargains, have well evinced the wisdom of our ancient law.

Mortgage || Mortmain.

MORTIER, an ensign of dignity, which was borne by the chancellor and grand presidents of the parliament of France. That borne by the chancellor was a piece of cloth of gold, edged and turned up with ermine; and that of the first president was a piece of black velvet edged with a double row of gold lace.

MORTIFICATION, or GANGRENE. See MEDICINE and SURGERY *Index*.

MORTIFICATION, in religion, any severe penance observed on a religious account. See FAST.

MORTISE, or MORTOISE, in carpentry, &c. a kind of joint wherein a hole of a certain depth is made in a piece of timber, which is to receive another piece called a *tenon*.

MORTMAIN, or ALIENATION *in Mortmain* (*in mortua manu*), is an alienation of lands or tenements to any corporation, sole or aggregate, ecclesiastical or temporal *: but these purchases having been chiefly made by religious houses, in consequence whereof the lands became perpetually inherent in one dead hand, this hath occasioned the general appellation of *mortmain* to be applied to such alienations, and the religious houses themselves to be principally considered in forming the statutes of mortmain: in deducing the history of which statutes, it will be matter of curiosity to observe the great address and subtle contrivance of the ecclesiastics, in eluding from time to time the laws in being, and the zeal with which successive parliaments have pursued

* See *Corporation*.

Mortmain. them through all their finesses: how new remedies were still the parents of new evasions; till the legislature at last, though with difficulty, hath obtained a decisive victory.

By the common law any man might dispose of his lands to any other private man at his own discretion, especially when the feodal restraints of alienation were worn away. Yet in consequence of these it was always, and is still necessary, for corporations to have a license of mortmain from the crown, to enable them to purchase lands: for as the king is the ultimate lord of every fee, he ought not, unless by his own consent, to lose his privilege of escheats and other feodal profits, by the vesting of lands in tenants that can never be attainted or die. And such licenses of mortmain seem to have been necessary among the Saxons above 60 years before the Norman conquest. But, besides this general license from the king as lord paramount of the kingdom, it was also requisite, whenever there was a mesne or intermediate lord between the king and the alienor, to obtain his license also (upon the same feodal principles) for the alienation of the specific land. And if no such license was obtained, the king or other lord might respectively enter on the land so alienated in mortmain, as a forfeiture. The necessity of this licence from the crown was acknowledged by the Constitutions of Clarendon, in respect of advowsons, which the monks always greatly coveted, as being the groundwork of subsequent appropriations. Yet such were the influence and ingenuity of the clergy, that (notwithstanding this fundamental principle) we find that the largest and most considerable donations of religious houses happened within less than two centuries after the Conquest. And (when a license could not be obtained) their contrivance seems to have been this: That as the forfeiture for such alienations accrued in the first place to the immediate lord of the fee, the tenant who meant to alienate first conveyed his lands to the religious house, and instantly took them back again to hold as tenant to the monastery: which kind of instantaneous seisin was probably held not to occasion any forfeiture: and then, by pretext of some other forfeiture, surrender, or escheat the society entered into those lands in right of such their newly acquired signiory, as immediate lords of the fee. But when these donations began to grow numerous, it was observed that the feodal services, ordained for the defence of the kingdom, were every day visibly withdrawn; that the circulation of landed property from man to man began to stagnate: and that the lords were curtailed of the fruits of their signories, their escheats, wardships, reliefs, and the like: and therefore, in order to prevent this, it was ordained by the second of King Henry III.'s great charters, and afterwards by that printed in our common statute books, that all such attempts should be void, and the land forfeited to the lord of the fee.

Blackst. Comment.

But as this prohibition extended only to religious houses, bishops and other sole corporations were not included therein; and the aggregate ecclesiastical bodies (who, Sir Edward Coke observes, in this were to be commended, that they ever had of their counsel the best learned men that they could get) found many means to creep out of this statute, by buying in lands that were *bona fide* holden of themselves as lords of the fee, and thereby evading the forfeiture; or by taking long leases for years, which first introduced those extensive terms, for a thousand or more years, which are now so frequent in conveyances. This produced the statute *de religiosis*, 7 Edw. I.; which provided, that no person, religious or other whatsoever, should buy, or sell, or receive under pretence of a gift, or term of years, or any other title whatsoever, nor should by any art or ingenuity appropriate to himself, any lands or tenements in mortmain; upon pain that the immediate lord of the fee, or, on his default for one year, the lords paramount, and in default of all of them, the king, might enter thereon as a forfeiture. Mortmain.

This seemed to be a sufficient security against all alienations in mortmain: but as these statutes extended only to gifts and conveyances between the parties, the religious houses now began to set up a fictitious title to the land, which it was intended they should have, and to bring an action to recover it against the tenant; who, by fraud and collusion, made no defence, and thereby judgment was given for the religious house, which then recovered the land by a sentence of law upon a supposed prior title. And thus they had the honour of inventing those fictitious adjudications of right, which are since become the great assurance of the kingdom, under the name of *common* RECOVERIES. But upon this the statute of Westminster the second, 13 Edw. I. c. 32. enacted, that in such cases a jury shall try the true right of the demandants or plaintiffs to the land; and if the religious house or corporation be found to have it, they shall still recover seisin; otherwise it shall be forfeited to the immediate lord of the fee, or else to the next lord, and finally to the king, upon the immediate or other lord's default. And the like provision was made by the succeeding chapter, in case the tenants set up crosses upon their lands (the badges of knights templars and hospitallers) in order to protect them from the feudal demands of their lords, by virtue of the privileges of those religious and military orders. And so careful was this provident prince to prevent any future evasions, that when the statute of *quia emptores*, 18 Edw. I. abolished all sub-infeudations, and gave liberty for all men to alienate their lands to be holden of their next immediate lord, a proviso was inserted that this should not extend to authorize any kind of alienation in mortmain. And when afterwards the method of obtaining the king's license by writ of *ad quod dammum* was marked out by the statute 27 Edw. I. st. 2. it was farther provided by statute 34 Edw. I. st. 3. that no such license should be effectual without the consent of the mesne or intermediate lords.

Yet still it was found difficult to set bounds to ecclesiastical ingenuity: for when they were driven out of all their former holds, they devised a new method of conveyance, by which the lands were granted, not to themselves directly, but to nominal feoffees to the use of the religious houses; thus distinguishing between the possession and the use, and receiving the actual profits, while the seisin of the land remained in the nominal feoffee; who was held by the courts of equity (then under the direction of the clergy) to be bound in conscience to account to his *cestuy que use* for the rents and emoluments of the estate. And it is to these inventions that our practisers are indebted for the introduction of uses and trusts, the founda-

Mortmain. tion of modern conveyancing. But unfortunately for the inventors themselves, they did not long enjoy the advantage of their new device; for the statute 15 Richard II. c. 5. enacts, that the lands which had been so purchased to uses should be admortised by license from the crown, or else be sold to private persons; and that, for the future, uses shall be subject to the statutes of mortmain, and forfeitable like the lands themselves. And whereas the statutes had been eluded by purchasing large tracts of land adjoining to churches, and consecrating them by the name of *churchyards*, such subtile imagination is also declared to be within the compass of the statutes of mortmain. And civil or lay corporations, as well as ecclesiastical, are also declared to be within the mischief, and of course within the remedy provided by those salutary laws. And lastly, As during the times of popery lands were frequently given to superstitious uses, though not to any corporate bodies; or were made liable in the hands of heirs and devisees to the charge of obits, chantries, and the like, which were equally pernicious in a well-governed state as actual alienations in mortmain; therefore at the dawn of the Reformation, the statute 23 Hen. VIII. c. 10. declares, that all future grants of lands for any of the purposes aforesaid, if granted for any longer term than 20 years, shall be void.

But, during all this time, it was in the power of the crown, by granting a license of mortmain, to remit the forfeiture, so far as related to its own rights; and to enable any spiritual or other corporation to purchase and hold any lands or tenements in perpetuity: which prerogative is declared and confirmed by the statute 18 Edw. III. st. 3. c. 3. But as doubts were conceived at the time of the Revolution how far such license was valid, since the king had no power to dispense with the statutes of mortmain by a clause of *non obstante*, which was the usual course, though it seems to have been unnecessary; and as, by the gradual declension of mesne signiories through the long operation of the statute of *quia emptores*, the rights of intermediate lords were reduced to a very small compass; it was therefore provided by the statute 7 & 8 W. III. c. 37. that the crown for the future at its own discretion may grant licenses to alienate or take in mortmain, of whomsoever the tenements may be holden.

After the dissolution of monasteries under Hen. VIII. though the policy of the next popish successor affected to grant a security to the possessors of abbey lands, yet, in order to regain so much of them as either the zeal or timidity of their owners might induce them to part with, the statutes of mortmain were suspended for 20 years by the statute 1 & 2 P. & M. c. 8. and during that time any lands or tenements were allowed to be granted to any spiritual corporation without any license whatsoever. And long afterwards, for a much better purpose, the augmentation of poor livings, it was enacted by the statute 17 Car. II. c. 3. that appropriators may annex the great tithes to the vicarages, and that all benefices under 100l. per annum may be augmented by the purchase of lands, without license of mortman in either case; and the like provision hath been since made in favour of the governors of Queen Anne' bounty. It hath also been held, that the statute 13 Hen. VIII. before-mentioned, did not extend to any thing but superstitious uses; and that therefore a man may give lands for the maintenance of a school, an hospital, or any other charitable uses. But as it was apprehended from recent experience, that persons on their deathbeds might make large and improvident dispositions even for these good purposes, and defeat the political ends of the statutes of mortmain; it is therefore enacted by the statute 9 Geo. II. c. 36. that no lands or tenements, or money to be laid out thereon, shall be given for or charged with any charitable uses whatsoever, unless by deed indented, executed in the presence of two witnesses 12 kalender months before the death of the donor, and enrolled in the court of chancery within six months after its execution (except stocks in the public funds, which may be transferred within six months previous to the donor's death), and unless such gift be made to take effect immediately, and be without power of revocation; and that all other gifts shall be void. The two universities, their colleges, and their scholars upon the foundation of the colleges of Eton, Winchester, and Westminster, are excepted out of this act: but such exemption was granted with this proviso, that no college shall be at liberty to purchase more advowsons than are equal in number to one moiety of the fellows or students upon the respective foundations. Mortmain, Mortuary.

MORTUARY, in *Law*, is a sort of ecclesiastical heriot*, being a customary gift claimed by and due to the minister in very many parishes on the death of his parishioners. They seem originally to have been only a voluntary bequest to the church; being intended, as Lyndewode informs us from a constitution of Archbishop Langham, as a kind of expiation and amends to the clergy for the personal tithes, and other ecclesiastical duties, which the laity in their life time might have neglected or forgotten to pay. For this purpose, after the lord's heriot or best good was taken out, the second best chattel was reserved to the church as a mortuary. And therefore in the laws of King Canute, this mortuary is called *soul-scot* or *symbolum animæ*. And, in pursuance of the same principle, by the laws of Venice, where no personal tithes have been paid during the life of the party, they are paid at his death out of his merchandise, jewels, and other moveables. So also, by a similar policy in France, every man that died without bequeathing a part of his estate to the church, which was called *dying without confession*, was formerly deprived of Christian burial; or, if he died intestate, the relations of the deceased, jointly with the bishop, named proper arbitrators to determine what he ought to have given to the church, in case he had made a will. But the parliament, in 1409, redressed this grievance.

* See *Heriot*.

It was anciently usual in England to bring the mortuary to church along with the corpse when it came to be buried; and thence it is sometimes called a *corpse-present:* a term which bespeaks it to have been once a voluntary donation. However, in Bracton's time, so early as Henry III. we find it rivetted into an established custom; in so much that the bequests of heriots and mortuaries were held to be necessary ingredients in every testament of chattels. *Imprimis autem debet quilibet, qui testamentum fecerit, dominum suum de meliori re quam habuerit recognoscere; et postea ecclesiam de alia meliore:* the lord must have the best good left him as a heriot; and the church the second best as a mortuary.

Mortuary. tuary. But yet this custom was different in different places: *in quibusdam locis habet ecclesia melius animal de consuetudine; in quibusdam secundum, vel tertium melius; et in quibusdam nihil: et ideo consideranda est consuetudo loci.* This custom still varies in different places, not only as to the mortuary to be paid, but the person to whom it is payable. In Wales a mortuary or corse present was due upon the death of every clergyman to the bishop of the diocese; till abolished, upon a recompense given to the bishop, by the statute, 12 Ann. st. 2. c. 6. And in the archdeaconry of Chester a custom also prevailed, that the bishop, who is also archdeacon, should have, at the death of every clergyman dying therein, his best horse or mare, bridle, saddle, and spurs; his best gown or cloak, hat, upper garment under his gown, and tippet, and also his best signet or ring. But by statute 28 Geo. II. c. 6. this mortuary is directed to cease, and the act has settled upon the bishop an equivalent in its room. The king's claim to many goods, on the death of all prelates in England, seems to be of the same nature; though Sir Edward Coke apprehends, that this is a duty upon death, and not a mortuary: a distinction which seems to be without a difference. For not only the king's ecclesiastical character, as supreme ordinary, but also the species of the good claimed, which bear so near a resemblance to those in the archdeaconry of Chester, which was an acknowledged mortuary, puts the matter out of dispute. The king, according to the record vouched by Sir Edward Coke, is entitled to six things; the bishop's best horse or palfrey, with his furniture; his cloak or gown, and tippet; his cup and cover; his bason and ewer; his gold ring; and lastly, his *muta canum*, his mew or kennel of hounds.

This variety of customs with regard to mortuaries, giving frequently a handle to exactions on the one side, and frauds or expensive litigations on the other, it was thought proper by statute 21 Henry VIII. c. 6. to reduce them to some kind of certainty. For this purpose it is enacted, that all mortuaries, or corse-presents to parsons of any parish, shall be taken in the following manner, unless where by custom less or none at all is due; viz. for every person who does not leave goods to the value of ten marks, nothing; for every person who leaves goods to the value of ten marks and under 30 pounds, 3s. 4d.; if above 30 pounds, and under 40 pounds, 6s. 8d.; if above 40 pounds, of what value soever they may be, 10s. and no more. And no mortuary shall throughout the kingdom be paid for the death of any feme-covert; nor for any child; nor for any one of full age, that is not a housekeeper; nor for any wayfaring man; but such wayfaring man's mortuary shall be paid in the parish to which he belongs. And upon this statute stands the law of mortuaries to this day. Mortuary || Mosaic Law.

MORUS, the MULBERRY TREE, a genus of plants belonging to the monœcia class, and in the natural method ranking under the 53d order, *Scabridæ*. See BOTANY *Index*.

MOSA, in *Ancient Geography*, a river of Belgica, rising in Mount Vogesus on the borders of the Lingones, and which, after receiving a part of the Rhine called *Vahalis*, forms the island of the Batavi, and passes off into the sea, at the distance of 80 miles. Now called the *Maese*, or *Meuse*; rising in Champagne, on the borders of the county of Burgundy, or Franche Compté, at a village called *Meuse*, whence the appellation; and running north through Lorrain and Champagne into the Netherlands: it afterwards directs its course north-east and then west; and joining the Waal, runs to Dort, and falls into the German sea, a little below the Briel.

MOSÆ PONS, in *Ancient Geography*, supposed to be Maestricht, situated on the Maese. E. Long. 5. 40. N. Lat. 50. 55.

MOSAIC LAW, or the *Law of Moses*, is the most ancient that we know of in the world, and is of three kinds; the moral law, the ceremonial law, and the judicial law. The different manner in which each of these was delivered, may perhaps suggest to us a right idea of their different natures. The moral law, or ten commandments, for instance, was delivered on the top of the mountain, in the face of the whole world, as being of universal influence, and obligatory on all mankind. The ceremonial was received by Moses in private in the tabernacle, as being of peculiar concern, belonging to the Jews only, and destined to cease when the tabernacle was down, and the vail of the temple rent. As to the judicial law, it was neither so publicly nor so audibly given as the moral law, nor yet so privately as the ceremonial; this kind of law being of an indifferent nature, to be observed or not observed, as its rites suit with the place and government under which we live. The five books of Moses called the *Pentateuch*, are frequently styled, by way of emphasis *the Law*. This was held by the Jews in such veneration, that they would not allow it to be laid upon the bed of any sick person, lest it should be polluted by touching the dead. Wilson's *Archæol. Dict.*

A TABLE or HARMONY of the MOSAIC LAW, digested into proper HEADS, with REFERENCES to the several Parts of the PENTATEUCH where the respective Laws occur.

CLASS I. The Moral Law written on the two Tables, containing the Ten Commandments.

	Exod. chap.	Levitic. chap.	Numb. chap.	Deut. chap.
The *first table*, which includes				
The first commandment	20. 23.	—	—	5. 6. 13.
The second commandment,	20. 23. 34.	19. 20. 26.	—	4. 5. 6. 7. 8. 10. 11. 12. 13.
The third commandment,	20. 23.	—	—	5.

The

Mosaic Law.		Exod. chap.	Levitic. chap.	Numb. chap.	Deut. chap.	Mosaic Law.
	The fourth commandment,	20. 23. 31. 34. 35.	19. 23. 26.	—	—	
	The *second table* includes					
	The fifth commandment,	20. 22.	19.	—	5.	
	The sixth commandment,	20.	19.	—	5.	
	The seventh commandment,	20.	18. 19.	—	5. 23.	
	The eighth commandment,	20. 23.	19.	—	5.	
	The ninth commandment,	20. 23.	19.	—	5.	
	The tenth commandment,	20.	—	—	5.	
	The sum of both tables,	—	19.	—	6.	
	Class II. The Ceremonial Law may be fitly reduced to the following heads, viz.					
	Of the holy place,	20.	17.	—	12.	
	Of the matter and structure of the tabernacle,	25. 26. 27. 35.	—	—	—	
	Of the instruments of the same, viz.					
	The laver of brass,	30.	—	—	—	
	The altar of burnt offering,	27.	—	—	—	
	The altar of incense,	30.	—	—	—	
	The candlestick of pure gold,	25.	—	—	—	
	The table of shew-bread,	25. 26.	—	—	—	
	Of the priests and their vestments for glory and beauty,	28.	—	—	—	
	Of the choosing of the Levites,	—	—	18. 3. 8.	—	
	Of the priests office in general,	—	—	3. 18.	—	
	Of their office in teaching,	—	19. 10.	—	18. 12. 17. 31.	
	Of their office in blessing,	—	—	6.	—	
	Of their office in offering; which function largely spreading itself, is divided into those heads, viz.					
	What the sacrifice ought to be,	—	22.	—	15. 17.	
	Of the continual fire,	—	6.	—	—	
	Of the manner of the burnt offerings,	—	6. 7.	—	—	
	——— the peace offerings,	—	3. 7.	—	—	
	Of the manner of the sacrifices according to their several kinds, viz.					
	For sin committed through ignorance of the law,	—	4.	5.	—	
	For sin committed through ignorance of the fact,	—	5. 7.	—	—	
	For sin committed wittingly, yet not through impiety,	—	6.	5.	—	
	The special law of sacrifices for sin,	—	6. 7.	—	—	
	Of things belonging to the sacrifices,	—	2. 6. 7.	15.	—	
	Of the shew-bread,	—	24.	—	—	
	Of the lamps,	27.	24.	8.	—	
	Of the sweet incense,	30.	—	—	—	
	Of the use of ordinary oblations, whereof there were several kinds observed by the priests,					
	Of the consecration of the high priests and other priests,	29. 30.	6. 8.	—	—	
	Of the consecration and office of the Levites,	—	—	8.	—	
	Of the dwelling of the Levites,	—	—	35.	—	
	Of the anointing the altar, and all the instruments of the tabernacle,	29. 30.	—	—	—	
	Of the continual daily sacrifices,	29.	—	28.	—	
	Of the continual Sabbath day's sacrifices,	—	—	28.	—	
	Of the solemn sacrifice for feast days, which were diverse, and had peculiar rites, distinguished into these, viz.					
	Of trumpets,	—	—	10.	—	
	Of beginning of months,	—	—	28.	—	
	Of the three most solemn feasts in general,	23. 34.	23.	—	16.	
	Of the feast of passover,	12. 13. 25. 34.	23.	9. 28.	16.	
	Of the feast of pentecost,	23. 24.	23.	28.	16.	
	Of the feast of tabernacles,	23. 34.	23.	29.	16.	
	Of the feast of blowing the trumpets,	—	23.	29.	—	

Mosaic Law.	Exod. chap.	Levitic. chap.	Numb. chap.	Deut. chap.	Mosaic Law.
Of the feast of expiation,	30.	16. 23.	29.	—	
Of the first fruits,	22. 23. 34.	2.	15.	26.	
Of tythes,	—	21.	18.	12. 14. 26.	
Of fruits growing and not eaten of,	—	19.	—	—	
Of the first born,	13. 22. 34.	—	—	15.	
Of the sabbatical year,	23.	25.	—	—	
Of the year of jubilee,	—	25.	—	—	
Of vows in general,	—	27.	30.	13.	
What persons ought not to make vows,	—	—	30.	—	
What things cannot be vowed,	—	27.	—	23.	
Of redemption of vows,	—	27.	—	—	
Of the vows of the Nazarites,	—	—	6.	—	
Of the laws proper for the priests, viz.					
Of pollutions,	—	22.	—	—	
Of the high priest's mourning,	—	21.	—	—	
Of his marriage,	—	21.	—	—	
Of the mourning of the ordinary priests,	—	21.	—	—	
Of their marriage,	—	21.	—	—	
Of their being forbidden the use of wine, &c.	—	10.	—	—	
Of sanctified meats,	—	6. 17. 19. 20.	5. 18.	12. 15. 18.	
Of the office of the Levites, viz.					
Teaching,	—	—	—	17. 27. 31.	
Offering,	—	—	3. 4. 18.	10.	
Other promiscuous ceremonial laws, viz.					
Of uncleanness in general,	—	15. 19.	5.	—	
Of uncleanness in meats, viz.					
Of blood, Gen. ix.	23.	7. 17. 19.	—	12.	
Of fat,	—	3. 7.	—	—	
Of dead carcases,	22.	17.	—	14.	
Other meats, and diverse living creatures,	—	11. 20.	—	14.	
Of uncleanness in the issue of seed and blood,	—	15. 12.	—	23.	
In the dead bodies of men,	—	—	19.	—	
In the leprosy,	—	13. 14.	5.	—	
Of circumcision, Gen. xvii.	—	12.	—	—	
Of the water of expiation,	—	—	19.	—	
Of the mourning of the Israelites,	—	19.	—	14.	
Of mixtures,	—	19.	—	14.	
Of their garments, and writing the law privately,	—	—	15.	6. 11. 22.	
Of young birds not to be taken with the dam,	—	—	—	22.	
Of their paddle staves,	—	—	—	23.	

CLASS III. The Political Law,

N. B. The Magistrate is the keeper of the precepts of both Tables, and to have respect to human society;—therefore the Political laws of the Israelites are referred to both the Tables, and are to be reduced to the several precepts of the Moral Law.

Laws referred to the first table, namely,

1st, To the first and second commandments, viz.

Of idolaters and apostates,	22.	20.	—	13. 17.	
Of abolishing idolatry,	23. 24.	—	33.	7. 12.	
Of diviners and false prophets,	22.	19. 20.	—	18.	
Of covenants with other gods,	23. 24.	—	—	7.	
2d, To the third commandment, viz.					
Of blasphemies,	—	24.	15.	—	
3d, To the fourth commandment, viz.					
Of breaking the Sabbath,	31 35.	—	15.	—	

Political laws referred to the second table,

1st, To

Mosaic Law.	Exod. chap.	Levitic. chap.	Numb. chap.	Deut. chap.
1st, To the fifth commandment, viz.				
Of magistrates and their authority,	18. 30.	—	11.	1. 13. 17. 23.
Of the power of fathers,				
2d, To the sixth commandment, viz.				
Of capital punishments,	—	—	—	21. 24
Of wilful murder,	21.	24.	35.	19.
Of manslaughter unwittingly committed, and of the cities of refuge,	21.	—	35.	19.21.22.
Of heinous injury,	21.	24.	—	25.
Of punishments not capital,	—	—	—	25.
Of the law of war,	—	—	—	25.
3d, To the seventh commandment, viz.				
Of unlawful marriages,	—	18. 20.	—	7. 21.
Of fornication,	—	19.	—	23.
Of whoredom,	22.	21.	—	22.
Of adultery and jealousy,	—	19. 20.	—	—
Of copulation against nature,	22.	18. 22.	—	—
Of divorcements,	—	—	—	24.
Other matrimonial laws,	21.	18. 20.	—	21.22.24. 25.
4th, To the eighth commandment, viz.				
Of the punishment of thefts,	22.	—	5.	—
Of sacrilege,	—	—	—	—
Of not injuring strangers,	22. 23.	19.	—	10.
Of not defrauding hirelings,	—	19.	—	26. 25.
Of just weights,	—	19.	—	25.
Of removing the land-mark,	—	—	—	19.
Of lost goods,	22.	—	—	—
Of strayed cattle,	22. 23.	—	—	22.
Of corrupted judgments,	23.	19.	—	16. 24.
Of fire breaking out by chance,	22.	—	—	—
Of manstealing,	—	—	—	24.
Of the fugitive servant,	—	—	—	23.
Of gathering fruits,	—	19. 23.	—	23. 24.
Of contracts, viz.				
Borrowing,	—	—	—	15.
Of the pledge,	22.	—	—	24.
Of usury,	22.	25.	—	23.
Of selling,	21.	25.	—	15.
Of the thing lent,	22.	—	—	—
Of a thing committed to be kept,				
Of heirs,				
5th, To the ninth commandment, viz.				
Of witnesses,	—	5.	—	17. 19.
The establishing the political law,	—	—	—	4.
The establishing the divine law in general,	—	—	—	6. 11. 29. 30. 31.
From the dignity of the lawgiver,	—	19.20.22.	15.	4.5.6.7.8. 10.26.27.
From the excellency of the laws,	—	—	—	4.26.
From the promises,	15.19.23. 24.	18. 26.	—	4. 5. 6. 7. 10.11.12. 28.
From the threatenings,	23.	26.	—	4. 7. 11. 27.28.29. 30.

MOSAIC, or MOSAIC WORK, an assemblage of little pieces of glass, marble, precious stones, &c. of various colours, cut square, and cemented on a ground of stucco, in such a manner as to imitate the colours and gradations of painting. The critics are divided as to the origin and reason of the name. Some derive it

Mosaic. it from *mosaicum*, a corruption of *musaicum*, as that is of *musivum*, as it was called among the Romans. Scaliger derives it from the Greek μυτα, and imagines the name was given to this sort of works as being very fine and ingenious. Nebricensis is of opinion it was so called, because *ex illis picturis ornabantur musca.*

1. Method of performing mosaic work of glass is this: They provide little pieces of glass, of as many different colours and sizes as possible.

Now, in order to apply these several pieces, and out of them to form a picture, they in the first place procure a cartoon, or design to be drawn; this is transferred to the ground or plaster by chalking as in painting in fresco. See FRESCO.

As this plaster is to be laid thick on the wall, and therefore will continue fresh and soft a considerable time, so there may be enough prepared at once to serve for as much work as will take up three or four days.

This plaster is composed of lime made of hard stone, with brick dust very fine, gum tragacanth, and whites of eggs; when this plaster has been thus prepared and laid on the wall, and made the design of what is to be represented, they take out the little pieces of glass with a pair of plyers, and range them one after another, still keeping strictly to the light, shadow, different teints and colours represented in the design before; pressing or flatting them down with a ruler, which serves both to sink them within the ground and to render the surface even.

Thus, in a long time, and with a great deal of labour, they finish the work, which is still the more beautiful, as the pieces of glass are more uniform and ranged at an even height.

Some of these pieces of mosaic work are performed with that exactness, that they appear as smooth as a table of marble, and as finished and masterly as a painting in fresco; with this advantage, that they have a fine lustre, and will last ages.

The finest works of this kind that have remained till our time, and those by whom the moderns have retrieved the art, which was in a manner lost, are those in the church of St Agnes, formerly the temple of Bacchus, at Rome; and some at Pisa, Florence, and other cities of Italy. The most esteemed among the works of the moderns are those of Joseph Pine and the Chevalier Lanfrane, in the church of St Peter at Rome: there are also very good ones at Venice.

2. The method of performing mosaic work of *marble* is this: The ground of mosaic works, wholly marble, is usually a massive marble either white or black. On this ground the design is cut with a chisel, after it has been first chalked. After it has been cut of a considerable depth, i. e. an inch or more, the cavities are filled up with marble of a proper colour, first fashioned according to the design, and reduced to the thickness of the indentures with various instruments. To make the piece thus inserted into the indentures cleave fast, whose several colours are to imitate those of the design, they use a stucco, composed of lime and marble dust; or a kind of mastich, which is prepared by each workman, after a different manner peculiar to himself. The figures being marked out, the painter or sculptor himself draws with a pencil the colours of the figures not determined by the ground, and in the same manner makes strokes or hatchings in the place where shadows are to be: and after he has engraven with the chisel all the strokes thus drawn, he fills them up with a black mastich, composed partly of Burgundy pitch poured on hot; taking off afterwards what is superfluous with a piece of soft stone or brick, which, together with water and beaten cement, takes away the mastich, polishes the marble, and renders the whole so even that one would imagine it only consisted of one piece. This is the kind of mosaic work that is seen in the church of the Invalids at Paris, and the fine chapel at Versailles, with which some entire apartments of that palace are incrustated. Mosaic.

3. As for mosaic work of precious stones, other and finer instruments are required than those used in marble; as drills, wheels, &c. used by lapidaries and engravers on stone. As none but the richest marbles and stones enter this work, to make them go the farther, they are sawn into the thinnest leaves imaginable, scarcely exceeding half a line in thickness; the block to be sawn is fastened firmly with cords on the bench, and only raised a little on a piece of wood, one or two inches high. Two iron pins, which are on one side the block, and which serve to fasten it, are put into a vice contrived for the purpose; and with a kind of saw or bow, made of a fine brass wire, bent on a piece of spongy wood, together with emery steeped in water, the leaf is gradually fashioned by following the stroke of the design made on paper, and glued on the piece. When there are pieces enough fastened to form an entire flower, or some other part of the design, they are applied to the ground.

The ground which supports this mosaic work is usually of freestone. The matter with which the stones are joined together is a mastich, or kind of stucco, laid very thin on the leaves as they are fashioned; and this being done, the leaves are applied with plyers.

If any contour, or side of a leaf, be not either squared or rounded sufficiently, so as to fit the place exactly into which it is to be inserted, when it is too large, it is to be brought down with a brass file or rasp; and if it be too little, it is managed with a drill and other instruments used by lapidaries.

Mosaic work of marble is used in large works, as in pavements of churches and palaces; and in the incrustation and veneering of the walls of the same edifices.

As for that of precious stones, it is only used in small works, as ornaments for altar pieces, tables for rich cabinets, precious stones being so very dear.

4. Manner of performing mosaic work of *gypsum*. Of this stone calcined in a kiln, beaten in a mortar and sifted, the French workmen make a sort of artificial marbles, imitating precious stones; and of these they compose a kind of mosaic work, which does not come far short either of the durableness or the vivacity of the natural stones; and which besides has this advantage that it admits of continued pieces or paintings of entire compartments without any visible joining.

Some make the ground of plaster of Paris, others of freestone. If it be of plaster of Paris, they spread it in a wooden frame, of the length and breadth of the work intended, and in thickness about an inch and a half. This frame is so contrived, that the tenons being only joined to the mortises by single pins, they may be taken asunder, and the frame be dismounted when the plaster is dry. The frame is covered on one side with a strong linen cloth, nailed all round; which being

Mosaic. placed horizontally with the linen at the bottom, is filled with plaster passed through a wide sieve. When the plaster is half dry, the frame is set up perpendicularly, and left till it is quite dry; then it is taken out, by taking the frame to pieces.

In this mosaic, the ground is the most important part. Now in order to the preparation of this sifted gypsum, which is to be applied on this ground, it is dissolved and boiled in the best English glue, and mixed with the colour that it is to be of; then the whole is worked up into the usual consistence of plaster, and then taken and spread on the ground five or six inches thick. If the work be such, as that mouldings are required, they are formed with gouges and other instruments.

It is on this plaster, thus coloured like marble or precious stone, and which is to serve as a ground to a work, either of lapis, agate, alabaster, or the like, that the design to be represented is drawn: having been first pounced or chalked. To hollow or impress the design, they use the same instruments that sculptors do; the ground whereon they are to work not being much less hard than the marble itself. The cavities being thus made in the ground, are filled with the same gypsum boiled in glue, only differently coloured, and thus are the different colours of the original represented. In order that the necessary colours and teints may be ready at hand, the quantities of the gypsum are tempered with the several colours in pots. After the design has been thus filled and rendered visible, by half polishing it with brick and soft stone, they go over it again, cutting such plates as are either to be weaker or more shadowed, and filling them with gypsum; which work they repeat till all the colours being added one after the other, represent the original to the life. When the work is finished, they scour it with soft stone, sand, and water; after that with a pumice stone; and in the last place polish it with a wooden mullet and emery. Lastly, they give it a lustre, by smearing it over with oil, and rubbing it a long time with the palm of the hand, which gives it a lustre nowise inferior to that of natural marble.

5. In Clavigero's history of Mexico is described a curious kind of mosaic work, made by the ancient Mexicans of the most delicate and beautiful *feathers* of birds. They raised for this purpose various species of birds of fine plumage with which that country abounds, not only in the palaces of the king, where there were all sorts of animals, but likewise in private houses; and at certain seasons they carried off their feathers to make use of them on this kind of work, or to sell them at market. They set a high value on the feathers of those wonderful little birds which they call *Huitzitzilin*, and the Spaniards *Picaflores*, on account of the smallness, the fineness, and the various colours of them. In these and other beautiful birds, nature supplied them with all the colours which art can produce, and also some which art cannot imitate. At the undertaking of every mosaic work several artists assembled: After having agreed upon a design, and taken their measures and proportions, each artist charged himself with the execution of a certain part of the image, and exerted himself so diligently in it, with such patience and application, that he frequently spent a whole day in adjusting a feather; first trying one, then another, viewing it sometimes one way, then another, until he found one which gave his part that ideal perfection proposed to be attained. When the part which each artist undertook was done, they assembled again to form the entire image from them.—If any part was accidentally the least deranged, it was wrought again until it was perfectly finished. They laid hold of the feathers with small pinchers, that they might not do them the least injury, and pasted them on the cloth with *tzauhtli*, or some other glutinous matter; then they united all the parts upon a little table, or a plate of copper, and flattened them softly until they left the surface of the image so equal and smooth that it appeared to be the work of a pencil. Mosaic, Mosambique.

These were the images so much celebrated by the Spaniards and other European nations. Whoever beheld them was at a loss whether he ought to have praised most the life and beauty of the natural colours, or the dexterity of the artist and the ingenious disposition of art. "These images (says Acosta) are deservedly admired; for it is wonderful how it was possible, with the feathers of birds, to execute works so fine and so equal, that they appear the performance of the pencil; and, what neither the pencil nor the colours in painting can effect, they have, when viewed from a side, an appearance so beautiful, so lively, and animated, that they give delight to the sight. Some Indians, who are able artists, copy whatever is painted with a pencil so perfectly with plumage, that they rival the best painters of Spain." These works of feathers were even so highly esteemed by the Mexicans as to be valued more than gold. Cortes, Bernal Diaz, Gomara, Torquemada, and all the other historians who saw them, were at a loss for expressions sufficient to praise their perfection. Several works of this kind, our author says, are still preserved in the museums of Europe, and many in Mexico; but few, he apprehends, belong to the 16th century, and still fewer, if any, are of those made before the conquest. The mosaic works also which the Mexicans made of broken shells were extremely curious: this art is still practised in Guatimala.

MOSAMBIQUE, a kingdom of Africa, lying south of Quiloa, and taking its name from the chief town, which is situated on an island, at the mouth of a river of the same name, in 15 deg. S. Lat. The island is 30 miles in circumference, and very populous. Though the air is said to be very hot, and the soil in general dry, sandy, and barren; yet they have most of the tropical fruits, with black cattle, hogs, and sheep. There is a kind of fowl here, both the feathers and flesh of which are black, insomuch that, when they are boiled, the broth looks like ink; and yet their flesh is very delicate and good food. The town of Mosambique is regularly fortified, and has a good harbour, defended by a citadel, with several churches and monasteries. The Portuguese shipping to and from India touch here for refreshments. As the island abounds in cattle, the Portuguese slaughter and salt up a great deal of beef, which they afterwards send to the Brazils, or sell to the European shipping. They also barter European goods with the natives for gold, elephants teeth, and slaves. There is another town, called *Mongala*, situated also on an island, and garrisoned by the Portuguese, being their chief magazine for European goods. The gold they receive from the natives is found near the surface of the earth, or in the sands

Mosambique || Moscow.

sands of rivers; no gold mines, or at least very few, being at present wrought in Africa.

MOSCHION, the name of four different writers, whose compositions, character, and native place, are unknown. Some fragments of their writings remain, some few verses, and a treatise *De mulierum affectibus*.

MOSCHUS, a Grecian poet of antiquity, usually coupled with Bion; and they were both of them contemporaries with Theocritus. In the time of the latter Grecians, all the ancient idylliums were collected and attributed to Theocritus; but the claims of Moschus and Bion have been admitted to some few little pieces; and this is sufficient to make us inquisitive about their characters and story; yet all that can be known about them must be collected from their own remains. Moschus, by composing his delicate elegy on Bion, has given the best memorials of Bion's life. See BION. Moschus and Theocritus have by some critics been supposed the same person; but there are irrefragable evidences against it: others will have him as well as Bion to have lived later than Theocritus, upon the authority of Suidas: while others again suppose him to have been the scholar of Bion, and probably his successor in governing the poetic school; which, from the elegy of Moschus, does not seem unlikely. Their remains are to be found in all the editions of the *Poetæ Minores*.

MOSCHUS, a genus of quadrupeds, of the order of pecora, having no horns. See MAMMALIA *Index*.

MOSCOW, the chief province of the empire of Russia, deriving its name from the river Muscova, or Moskva, on which the capital is situated. It was from this duchy that the czars of old took the title of *dukes of Muscovy*. The province is bounded on the north by the duchies of Twere, Rostow, Susdal, and Wolodimer; on the south by Rezan, from which it is separated by the river Occa; on the east by the principality of Cachine, and the same river Occa parting it from Nisi-Novogorod; and on the west by the duchies of Rzeva, Bielar and Smolensko. It extends about 150 miles in length, by 100 in breadth, and contains 1,139,000 inhabitants on a surface of 10,000 square miles. It is watered by the Moskva, Occa, and Clesma, which fall into the Wolga: nevertheless, the soil is not very fertile. The air, though sharp, is salubrious; and this consideration, with the advantage of its being situated in the midst of the best provinces in the empire, induced the czars to make it their chief residence. In the western part of Moscow is a large forest, from whence flows the celebrated river Dnieper, or Borysthenes, which, traversing the duchy of Smolensko, winds in a serpentine course to Ukraine, Lithuania, and Poland.

Moscow, the capital of the above province, and till the beginning of the last century the metropolis of all Russia, is situated in a spacious plain on the banks of the river Moskva. E. Long. 37. 31. N. Lat. 55. 45. The Russian antiquaries differ considerably in their opinions concerning the first foundation of Moscow; the following relation, Mr Coxe says, is generally esteemed by the best authors the most probable account.

Kief was the metropolis, when George son of Vladimir Monomaka ascended in 1154 the Russian throne. That monarch, being insulted in a progress through his dominions by a rich and powerful nobleman named Stephen Kutchko, put him to death, and confiscated his domains, which consisted of the lands now occupied by the city of Moscow and the adjacent territory. Pleased with the situation of the ground lying at the conflux of the Moskva and Neglina, he laid the foundation of a new town, which he called Moskva from the river of that name. Upon the demise of George, the new town was not neglected by his son Andrew, who transferred the seat of empire from Kief to Vladimir; but it fell into such decay under his immediate successors, that when Daniel, son of Alexander Nevski, received, in the division of the empire, the duchy of Muscovy as his portion, and fixed his residence upon the conflux of the Moskva and Neglina, he may be said to have new founded the town. The spot now occupied by the Kremlin was at that time overspread with a thick wood and a morass, in the midst whereof was a small island containing a single wooden hut. Upon this part Daniel constructed churches and monasteries, and various buildings, and enclosed it with wooden fortifications: he first assumed the title of duke of Moscow; and was so attached to this situation, that when in 1304 he succeeded his brother Andrew Alexandrovich in the great duchy of Vladimir, he did not remove his court to Vladimir, but continued his residence at Moscow, which then became the capital of the Russian dominions. His successors followed his example; among whom his son Ivan considerably enlarged the new metropolis, and in 1367 his grandson Demetrius Ivanovitch Donski surrounded the Kremlin with a brick wall. These new fortifications, however, were not strong enough to prevent Tamerlane in 1382, from taking the town after a short siege. Being soon evacuated by that desultory conqueror, it again came into the possession of the Russians; but was frequently invaded and occupied by the Tartars, who in the 14th and 15th centuries overran the greatest part of Russia, and who even maintained a garrison in Moscow until they were finally expelled by Ivan Vassilievitch I. To him Moscow is indebted for its principal splendour, and under him it became the principal and most considerable city of the Russian empire. Moscow

Moscow continued the metropolis of Russia until the beginning of the 18th century, when, to the great dissatisfaction of the nobility, but with great advantage probably to the state, the seat of empire was transferred to Petersburgh.

Notwithstanding the predilection which Peter conceived for Petersburgh, in which all the succeeding sovereigns excepting Peter the II. have fixed their residence, Moscow, according to Mr Coxe, is still the most populous city of the Russian empire. Here the chief nobles who do not belong to the court reside: they here support a large number of retainers; they love to gratify their taste for a ruder and more expensive magnificence in the ancient style of feudal grandeur; and are not, as at Petersburgh, eclipsed by the superior splendour of the court.

Moscow, before its destruction in 1812, was represented as the largest town in Europe; its circumference within the rampart, which encloses the suburbs, being exactly 39 versts or 26 miles; but it was built in so straggling and disjointed a manner, that its population in no degree corresponded to its extent. According to a computation, which Mr Coxe says may be depended

Moscow. upon, Moscow contains within the ramparts 250,000 souls, and in the adjacent villages 50,000. The ground is about 1730 feet above the level of the sea, which renders the atmosphere rather cold. The streets of Moscow are in general exceedingly long and broad; some of them are paved; others, particularly those in the suburbs, are formed with trunks of trees, or are boarded with planks like the floor of a room; wretched hovels are blended with large palaces; cottages of one story stand next to the most superb and stately mansions. Many brick structures are covered with wooden tops; some of the wooden houses are painted; others have iron doors and roofs. Numerous churches present themselves in every quarter, built in a peculiar style of architecture; some with domes of copper, others of tin, gilt or painted green, and many roofed with wood. In a word, some parts of this vast city have the look of a sequestered desert, other quarters of a populous town; some of a contemptible village, others of a great capital.

Moscow may be considered as a town built upon the Asiatic model, but gradually becoming more and more European, and exhibiting in its present state a motley mixture of discordant architecture. It is distributed into the following divisions. 1. The Kremlin. This stands in the central and highest part of the city; is of a triangular form, and about two miles in circumference: and is surrounded by high walls of stone and brick; which were constructed in the year 1491, under the reign of Ivan Vassilievitch I. It contains the ancient palace of the czars, several churches, two convents, the patriarchal palace, the arsenal now in ruins, and one private house, which belonged to Boris Godunof before he was raised to the throne. 2. Khitaigorod, or the Chinese town, is enclosed on one side by that wall of the Kremlin which runs from the Moskva to the Neglina; and on the other side by a brick wall of inferior height. It is much larger than the Kremlin, and contains the university, the printing-house and many other public buildings, and all the tradesmen's shops. The edifices are mostly stuccoed or white-washed, and it has the only street in Moscow in which the houses stand close to one another without any intervals between them. 3. The Bielgorod, or White Town, which runs quite round the two preceding divisions, is supposed to derive its name from a white wall with which it was formerly enclosed, and of which some remains are still to be seen. 4. Semlainogorod, which environs all the three other quarters, takes its denomination from a circular rampart of earth with which it is encompassed. These two last mentioned divisions exhibit a grotesque groupe of churches, convents, palaces, brick and wooden houses, and mean hovels, in no degree superior to peasants cottages. 5. The Sloboda, or suburbs, form a vast exterior circle round all the parts already described, and are invested with a low rampart and ditch. These suburbs contain, beside buildings of all kinds and denominations, corn fields, much open pasture, and some small lakes, which give rise to the Neglina. The river *Moskva*, from which the city takes its name, flows through it in a winding channel; but excepting in spring is only navigable for rafts. It receives the Yausa in the Semlainogorod, and the Neglina at the western extremity of the Kremlin; the beds of both these last-mentioned rivulets are in summer little better than dry channels.

The places of divine worship at Moscow are exceedingly numerous; including chapels, they amount to above 1000: there are 484 public churches, of which 199 are of brick; and the others of wood; the former are commonly stuccoed or white-washed, the latter painted of a red colour. The most ancient churches of Moscow are generally square buildings, with a cupola and four small domes, some whereof are of copper or iron gilt; others of tin, either plain or painted green. These cupolas and domes are for the most part ornamented with crosses entwined with thin chains or wires. The church of the Holy Trinity, sometimes called the church of Jerusalem, which stands in the Khitaigorod, close to the gate leading into the Kremlin, has a kind of high steeple and nine or ten domes: it was built in the reign of Ivan Vassilievitch II. The inside of the churches is mostly composed of three parts: that called by the Greeks ὠδοτεος, by the Russians trapeza; the body; and the sanctuary or shrine. Over the door of each church is the portrait of the saint to whom it is dedicated, to which the common people pay their homage as they pass along, by taking off their hats, crossing themselves, and occasionally touching the ground with their heads. The bells, which form no inconsiderable part of public worship in this country, as the length or shortness of their peals ascertains the greater or lesser sanctity of the day, are hung in belfrys detached from the church: they do not swing like our bells; but are fixed immoveably to the beams, and are rung by a rope tied to the clapper and pulled sidewise. Some of these bells are of a stupendous size; one in the tower of St Ivan's church weighs 3551 Russian poods, or 127,836 English pounds. It has always been esteemed a meritorious act of religion to present a church with bells; and the piety of the donor has been measured by their magnitude. According to this mode of estimation, Boris Godunof, who gave a bell of 288,000 pounds to the cathedral of Moscow, was the most pious sovereign of Russia, until he was surpassed by the empress Anne, at whose expence a bell was cast weighing 432,000 pounds, and which exceeded in bigness every bell in the known world. The height of this enormous bell is 19 feet, its circumference at the bottom 21 yards 11 inches; its greatest thickness 23 inches. The beam to which this vast machine was fastened being accidentally burnt, the bell fell down, and a fragment was broken off towards the bottom, which left an aperture large enough to admit two persons abreast without stooping. Moscow

The palace, inhabited by the ancient czars, stands at the extremity of the Kremlin. Part of this palace is old, and remains in the same state in which it was built under Ivan Vassilievitch I. The remainder has been successively added at different intervals, without any plan, and in various styles of architecture, which has produced a motley pile of building, remarkable for nothing but the incongruity of the several structures. The top is thickly set with numerous little gilded spires and globes; and a large portion of the front is decorated with the arms of all the provinces which compose the Russian empire. The apartments are in general exceedingly small, excepting one single room called the council chamber, in which the ancient czars used to give audience to foreign ambassadors, and which has been repeatedly described by several English travellers who visited Moscow before the imperial residence was transferred to Petersburgh. The room is large and vaulted, and has in the centre an enormous

Moscow. enormous pillar of stone which supports the ceiling. In this palace Peter the Great came into the world, in the year 1672. In that part called the treasury are deposited the crown, jewels, and royal robes, used at the coronation of the sovereign, besides several curiosities relative to the history of the country. Of the great number of churches contained in this city, two in particular, namely, that of St Michael and that of the Assumption of the Virgin Mary, are remarkable; the one for being the place where the sovereigns of Russia were formerly interred, and the other where they are crowned. These edifices, which are situated in the Kremlin, are both in the same style of architecture; and their exterior form, though modelled according to the ancient style of the country, is not absolutely inelegant. In the cathedral of St Michael, which contains the tombs of the Russian sovereigns, the bodies are not, as with us deposited in vaults, or beneath the pavement, but are entombed in raised sepulchres, mostly of brick, in the shape of a coffin, and about two feet in height.

The cathedral of the Assumption of the Virgin Mary, which has long been appropriated to the coronation of the Russian sovereigns, is the most splendid and magnificent in Moscow. The screen is in many parts covered with plates of solid silver and gold richly worked. From the centre of the roof hangs an enormous chandelier of massy silver, weighing 2940 pounds: it was made in England, and was a present from Morosof, prime minister and favourite of Alexey Michaelovitch. The sacred utensils and episcopal vestments are extraordinarily rich, but the taste of the workmanship is in general rude, and by no means equal to the materials. Many of the paintings which cover the inside walls are of a colossal size: some are very ancient, and were executed so early as in the latter end of the 15th century. It contains, amongst the rest a head of the Virgin, supposed to have been delineated by St Luke, and greatly celebrated in this country for its sanctity and the power of working miracles.

The place in the Khitaigorod, where the public archives are deposited, is a strong brick building, containing several vaulted apartments with iron floors. These archives, consisting of a numerous collection of state papers, were crowded into boxes and thrown aside like common lumber, until the empress Catharine ordered them to be revised and arranged. In conformity to this mandate, Mr Muller has disposed them in chronological order with such perfect regularity, that any single document may be inspected with little trouble.

The university of Moscow, all situated in the Khitaigorod, was founded, at the instance of Count Shuvalof, by the empress Elizabeth, for 600 students; who are clothed, boarded, and instructed, at the expence of the crown. Besides this institution, there are two gymnasia or seminaries for the education of youth, endowed also by Elizabeth; in which are taught, by twenty-three professors, divinity, classics, philosophy, the Greek, Latin, Russian, German, French, Italian, and Tartar languages; history, geography, mathematics, architecture, fortification, artillery, algebra, drawing and painting, music, fencing, dancing, reading and writing.

Moscow is the centre of the inland commerce of Russia, and particularly connects the trade between Europe and Siberia. The only navigation to this city is formed by the Moskva, which falling into the Occa near Columna, communicates by means of that river with the Volga. But as the Moskva is only navigable in spring upon the melting of the snows, the principal merchandise is conveyed to and from Moscow upon sledges in winter. The whole of the retail trade is carried on in the Khitaigorod; where according to a custom common in Russia, as well as in most kingdoms of the East, all the shops are collected together in one spot. The place is like a kind of fair, consisting of many rows of low brick buildings; the intervals between them resembling alleys. These shops or booths occupy a considerable space; they do not, as with us, make part of the houses inhabited by the tradesmen, but are quite detached from their dwellings, which for the most part are at some distance in another quarter of the town. The tradesman comes to his shop in the morning, remains there all day, and returns home to his family, in the afternoon. Every trade has its separate department; and they who sell the same goods have booths adjoining to each other. Furs and skins form the most considerable article of commerce in Moscow; and the shops which vend those commodities occupy several streets. Moscow.

Amongst the curiosities of Moscow, the market for the sale of houses is not the least remarkable. It is held in a large open space in one of the suburbs; and exhibits a great variety of ready-made houses, thickly strewed upon the ground. The purchaser who wants a dwelling, repairs to this spot, mentions the number of rooms he requires, examines the different timbers, which are regularly numbered, and bargains for that which suits him. The house is sometimes paid for on the spot, and taken away by the purchaser; or sometimes the vender contracts to transport and erect it upon the place where it is designed to stand. It may appear incredible to assert, that a dwelling may be thus bought, removed, raised and inhabited, within the space of a week; but we shall conceive it practicable by considering that these ready-made houses are in general merely collections of trunks of trees tenoned and mortised at each extremity into one another, so that nothing more is required than the labour of transporting and adjusting them. But this summary mode of building is not always peculiar to the meaner hovels; as wooden structures of very large dimensions and handsome appearance are occasionally formed in Russia with an expedition almost inconceivable to the inhabitants of other countries. A remarkable instance of this dispatch was displayed the last time the empress came to Moscow. Her majesty proposed to reside in the mansion of Prince Galitzin, which is esteemed the completest edifice in this city; but as it was not sufficiently spacious for her reception, a temporary addition of wood, larger than the original house, and containing a magnificent suite of apartments, was begun and finished within the space of six weeks. This meteor-like fabric was so handsome and commodious, that the materials which were taken down at her majesty's departure, were to be re-constructed as a kind of imperial villa upon an eminence near the city. Mr Coxe mentions an admirable police in this city for preventing riots, or for stopping the concourse of people in case of fires, which are very frequent and violent in those parts, where the houses are mostly of wood, and the streets are laid with timber. At the entrance of each street there is a chevaux-de-frize gate, one end whereof turns upon a pivot, and the other rolls upon a wheel;

Moscow. wheel; near it is a centry box in which a man is occasionally stationed. In times of riot or fire the centinel shuts the gate, and all passage is immediately stopped.

Among the public institutions of Moscow, the most remarkable is the Foundling Hospital, endowed in 1764 by the empress Catharine, and supported by voluntary contributions and legacies, and other charitable gifts. In order to encourage donations, her majesty granted to all benefactors some valuable privileges, and a certain degree of rank in proportion to the extent of their liberality. Among the principal contributors must be mentioned a private merchant named *Dimidof*, a person of great wealth, who has expended in favour of this charity above 100,000l. The hospital, which is situated in a very airy part of the town upon a gentle ascent near the river Moskva, is an immense pile of building of a quadrangular shape, part of which was only finished when Mr Coxe (whose account we are transcribing) was at Moscow. It contained, at that time, three thousand foundlings; and, when the whole is completed, will receive eight thousand. The children are brought to the porter's lodge, and admitted without any recommendation. The rooms are lofty and large; the dormitories, which are separate from the work rooms, are very airy, and the beds are not crowded: each foundling, even each infant, has a separate bed. The children remain two years in the nursery, when they are admitted into the lowest class; the boys and girls continue together until they are seven years of age, at which time they are separated. They all learn to read, write, and cast accounts. The boys are taught to knit; they occasionally card hemp, flax, and wool, and work in the different manufactures. The girls learn to knit, net, and all kinds of needle work; they spin and weave lace; they are employed in cookery, baking, and house work of all sorts. At the age of fourteen the foundlings enter into the first class, when they have liberty of choosing any particular branch of trade; and for this purpose there are different species of manufactures established in the hospital, of which the principal are embroidery, silk stockings, ribbands, lace, gloves, buttons, and cabinet work. A separate room is appropriated to each trade. Some boys and girls are instructed in the French and German languages, and a few boys in the Latin tongue; others learn music, drawing, and dancing.

Such was Moscow previous to 1812. The battle of Borodino, on the 7th September, which was gained by the French, though hardly contested, opened their way to this ancient capital of the empire. They entered it on the 15th September; but the governor Rostopchin had previously taken measures for its destruction; and the French had hardly got possession, when they discovered that the city was in flames in many different quarters. The greater part of the inhabitants had withdrawn with the governor. From the love of pillage, the French soldiers, at first, rather aided the progress of the fire; and when they afterwards endeavoured to stop its course, their efforts were of little avail. The conflagration began on the night of the 14th, and raged with unceasing fury till the 19th; about three-fourths of the city were destroyed. Great and unprecedented as this sacrifice was, it was justified by the happy result it produced. It defeated Bonaparte's purpose of remaining there through the winter, compelled him to make a disastrous retreat, which so completely broke his strength as to lead to the final overthrow of his power. Large sums were collected in Britain and elsewhere in behalf of the suffering inhabitants; and, according to late accounts, the city is rising rapidly from its ruins. Moscow was evacuated by the French on the 23d October, after they had destroyed some parts of the town which had escaped the fire. Their attempts to blow up the Kremlin were prevented by the sudden arrival of a large Russian force. Moscow || Moses.

MOSELLE, a river of Germany, which rises in the mountains of Vosges in Lorraine, and falls into the Rhine at Coblentz.

MOSELLE is also the name of a department of France, which includes part of the late province of Lorrain. Its population in 1800 was 353,788 upon a surface of 2525 square miles.

MOSES, the son of Amram and Jochebed, was born in the year 1571 before Christ. Pharaoh king of Egypt, perceiving that the Hebrews were become a formidable nation, issued forth an edict commanding all the male children to be put to death. To avoid this cruel edict, Jochebed, the mother of Moses, having concealed her son for three months, at length made an ark or basket of bulrushes, daubed it with pitch, laid the child in it, and exposed him on the banks of the Nile. Thermuthis the king's daughter, who happened to be walking by the river's side, perceived the floating cradle, commanded it to be brought to her, and struck with the beauty of the child, determined to preserve his life. In three years afterwards the princess adopted him for her own son, called his name *Moses*, and caused him be diligently instructed in all the learning of the Egyptians. But his father and mother, to whom he was restored by a fortunate accident, were at still greater pains to teach him the history and religion of his fathers. Many things are related by historians concerning the first period of Moses's life, which are not to be found in the Old Testament. According to Josephus and Eusebius, he made war on the Ethiopians, and completely defeated them. They add, that the city Saba, in which the enemy had been forced to take refuge, was betrayed into his hands by the king's daughter, who became deeply enamoured of him, when she beheld from the top of the walls his valorous exploits at the head of the Egyptian army. But as the truth of this expedition is more than doubtful, we shall therefore confine ourselves to the narrative of sacred writ, which commences at the fortieth year of Mose's life. He then left the court of Pharaoh, and went to visit his countrymen the Hebrews, who groaned under the ill usage and oppression of their unfeeling masters. Having perceived an Egyptian smiting a Hebrew, he slew the Egyptian, and buried him in the sand. But he was obliged, in consequence of this murder, to fly into the land of Midian, where he married Zipporah, daughter of the priest Jethro, by whom he had two sons, Gershom and Eliezar. Here he lived 40 years; during which time his employment was to tend the flocks of his father-in-law. Having one day led his flock towards Mount Horeb, God appeared to him in the midst of a bush which burned with fire but was not consumed, and commanded him to go and deliver his brethren from their bondage. Moses at first refused to go; but was at length prevailed on by two miracles

Moses. racles which the Almighty wrought for his conviction. Upon his return to Egypt, he, together with his brother Aaron, went to the court of Pharoah, and told him that God commanded him to let the Hebrews go to offer sacrifices in the desert of Arabia. But the impious monarch disregarded this command, and caused the labour of the Israelites to be doubled. The messengers of the Almighty again returned to the king, and wrought a miracle in his sight, that they might move his heart, and induce him to let the people depart. Aaron having cast down his miraculous rod, it was immediately converted into a serpent: but the same thing being performed by the magicians, the king's heart was hardened more and more; and his obstinacy at last drew down the judgments of the Almighty on his kingdom, which was afflicted with ten dreadful plagues. The first was the changing of the waters of the Nile and of all the rivers into blood, so that the Egyptians died of thirst. In consequence of the second plague, the land was covered with innumerable swarms of frogs, which entered even into Pharaoh's palace. By the third plague, the dust was converted into lice, which cruelly tormented both man and beast. The fourth plague was a multitude of destructive flies which spread throughout Egypt, and infested the whole country. The fifth was a sudden pestilence, which destroyed all the cattle of the Egyptians, without injuring those of the Israelites. The sixth produced numberless ulcers and fiery boils upon man and upon beast. The seventh was a dreadful storm of hail, accompanied with thunder and lightning, which destroyed every thing that was in the field, whether man or beast, and spared only the land of Goshen, where the children of Israel dwelt. By the eighth plague swarms of locusts were brought into the country, which devoured every green herb, the fruit of the trees and the produce of the harvest. By the ninth plague thick darkness covered all the land of Egypt, except the dwellings of the children of Israel. The tenth and last plague was the death of the firstborn in Egypt, who were all in one night cut off by the destroying angel, from the firstborn of the king to the firstborn of the slaves and of the cattle. This dreadful calamity moved the heart of the hardened Pharaoh, and he at length consented to allow the people of Israel to depart from his kingdom.

Profane authors who have spoken of Moses, seem to have been in part acquainted with these mighty wonders. That he performed miracles, must have been allowed by many, by whom he was considered as a famous magician; and he could scarcely appear in any other light to men who did not acknowledge him for the messenger of the Almighty. Both Diodorus and Herodotus mention the distressed state to which Egypt was reduced by these terrible calamities. The Hebrews, amounting to the number of 600,000 men, without reckoning women and children, left Egypt on the 15th day of the month Nisan, which, in memory of this deliverance, was thenceforth reckoned the first month of their year. Scarcely had they reached the shore of the Red sea when Pharaoh with a powerful army set out in pursuit of them. On this occasion Moses stretched forth his rod upon the sea; and the waters thereof being divided, remained suspended on both sides till the Hebrews passed through dry-footed.—The Egyptians determined to follow the same course; but God caused a violent wind to blow, which brought back the waters to their bed, and the whole army of Pharaoh perished in the waves. Moses.

After the miraculous passage of the Red sea, the army proceeded towards Mount Sinai, and arrived at Marah, where the waters were bitter; but Moses, by casting a tree into them, rendered them fit for drinking. Their tenth encampment was at Rephidim, where Moses drew water from the rock in Horeb, by smiting it with his rod. Here likewise Amalek attacked Israel. While Joshua fought against the Amalekites, Moses stood on the top of a hill, and lifted up his hands; in consequence of which the Israelites prevailed, and cut their enemies in pieces. They at length arrived at the foot of Mount Sinai on the third day of the ninth month after their departure from Egypt. Moses having ascended several times into the mount, received the law from the hand of God himself in the midst of thunders and lightnings, and concluded the famous covenant betwixt the Lord and the children of Israel. When he descended from Sinai, he found that the people had fallen into the idolatrous worship of the golden calf. The messenger of God, shocked at such ingratitude, broke in pieces the tables of the law which he carried in his hands, and put 23,000 of the transgressors to the sword. He afterwards reascended into the mountain, and there obtained new tables of stone on which the law was inscribed. When Moses descended, his face shone so that the Israelites dared not to come nigh unto him, and he was obliged to cover it with a veil. The Israelites were here employed in constructing the tabernacle according to a pattern shown them by God. It was erected and consecrated at the foot of the Mount Sinai on the first day of the first month of the second year after their departure from Egypt; and it served the Israelites instead of a temple till the time of Solomon, who built a house for the God of his fathers after a model shown him by David.

Moses having dedicated the tabernacle, he consecrated Aaron and his sons to be its ministers, and appointed the Levites to its service. He likewise gave various commandments concerning the worship of God and the political government of the Jews. This was a *theocracy* in the full extent of the word. God himself governed them immediately by means of his servant Moses, whom he had chosen to be the interpreter of his will to the people; and he required all the honours belonging to their king to be paid unto himself. He dwelt in his tabernacle, which was situated in the middle of the camp, like a monarch in his palace. He gave answers to those who consulted him, and himself denounced punishment against the transgressors of his laws. This properly was the time of the theocracy, taken in its full extent; for God was not only considered as the divinity who was the object of their religious worship, but as the sovereign to whom the honours of supreme majesty were paid. The case was nearly the same under Joshua; who, being filled with the spirit of Moses, undertook nothing without consulting God. Every measure, both of the leader and of the people, was regulated by the direction of the Almighty, who rewarded their fidelity and obedience by a series of miracles, victories, and successes. After Moses had regulated every thing regarding the civil administration,

Moses, Mosheim.

tion, and the marching of the troops, he led the Israelites to the confines of Canaan, to the foot of Mount Nebo. Here the Lord commanded him to ascend into the mountain; whence he showed him the promised land, whereinto he was not permitted to enter. He immediately after yielded up the ghost, without sickness or pain, in the 120th year of his age, and 1451 years before Jesus Christ.

Moses is incontestably the author of the first five books of the Old Testament, which go by the name of the *Pentateuch;* and which are acknowledged to be inspired, by the Jews and by Christians of every persuasion. Some, however, have denied that Moses was the author of these books; and have founded their opinion on this, that he always speaks of himself in the third person. But this manner of writing is by no means peculiar to Moses; it occurs also in several ancient historians; such as Xenophon, Cæsar, Josephus, &c. who possessed of more modesty or good sense than some modern historians, whose egotism is altogether disgusting, have not like them left to posterity a spectacle of ridiculous vanity and self-conceit. After all, it is proper to observe, that profane authors have related many falsehoods and absurdities concerning Moses, and concerning the origin and the religion of the Jews, with which they were but little acquainted. Plutarch, in his book concerning Isis and Osiris, says, that Judæus and Hierosolymus were brothers, and descended from Typhon; and that the former gave his name to the country and its inhabitants, and the latter to the capital city. Others say that they came from Mount Ida in Phrygia. Strabo is the only author who speaks any thing like reason and truth concerning them; though he too says that they were descended from the Egyptians, and considers Moses their legislator as an Egyptian priest. He acknowledges, however, that they were a people strictly just and sincerely religious. Other authors by whom they are mentioned, seem not to have had the smallest acquaintance either with their laws or their worship. They frequently confound them with the Christians, as is the case with Juvenal, Tacitus, and Quintilian.

MOSHEIM, John Laurence, an illustrious German divine, was born in 1695, of a noble family, which might seem to open to his ambition a fair path to civil promotion; but his zeal for the interests of religion, his thirst after knowledge, and particularly his taste for sacred literature, induced him to consecrate his talents to the service of the church. The German universities loaded him with literary honours; the king of Denmark invited him to settle at Copenhagen; the duke of Brunswick called him thence to Helmstadt, where he filled the academical chair of divinity; was honoured with the character of ecclesiastical counsellor to the court; and presided over the seminaries of learning in the duchy of Wolfenbuttle and the principality of Blackenburgh. When a design was formed of giving an uncommon degree of lustre to the universities of Gottingen, by filling it with men of the first rank in letters, Dr Mosheim was deemed worthy to appear at the head of it, in quality of chancellor; and here he died, in 1755, universally lamented. In depth of judgment, in extent of learning, in purity of taste, in the powers of eloquence, and in a laborious application to all the various branches of erudition and philosophy, he had certainly very few superiors. His Latin translation of Cudworth's Intellectual System, enriched with large annotations, discovered a profound acquaintance with ancient learning and philosophy. His illustrations of the Scriptures, his labours in defence of Christianity, and the light he cast upon religion and philosophy, appear in many volumes of sacred and profane literature; and the Ecclesiastical History, from the birth of Christ to the beginning of the 18th century, is unquestionably the best that is extant. This work, written in Latin, has been translated into English, and accompanied with notes and chronological tables by Archibald Maclaine, D. D. and from this translator's preface to the second edition, 1758, in 5 vols 8vo, this short account is taken.

Mosheim || Mosque.

MOSKITO, or Mosquito country, is situated in North America, between 85 and 88 degrees of west longitude, and between 13 and 15 degrees of north latitude; having the North sea on the north and east, Nicargua on the south, and Honduras on the west; and indeed the Spaniards esteem it a part of the principality of Honduras, though they have no colonies in the Moskito country. When the Spaniards first invaded this part of Mexico, they massacred the greatest part of the natives, which gave those that escaped into the inaccessible part of the country an insuperable aversion to them; and they have always appeared ready to join any Europeans that come upon their coasts against the Spaniards, and particularly the English, who frequently come hither; and the Moskito men being excellent marksmen, the English employ them in striking the manati fish, &c. and many of the Moskito Indians come to Jamaica, and sail with the English in their voyages.

These people are so situated between morasses and inaccessible mountains, and a coast full of rocks and shoals, that no attempts against them by the Spaniards, whom they mortally hate, could ever succeed. Nevertheless, they are a mild inoffensive people, of great morality and virtue, and will never trust a man who has once deceived them. They have so great a veneration towards the English, that they have spontaneously put themselves and their lands under the protection and dominion of the crown of England. This was first done when the duke of Albermarle was governor of Jamaica, and the king of the Moskitos received a commission from his grace, under the seal of that island; and since this time they have been steady in their alliance with the English. But in the year 1786, this country was ceded to Spain, and consequently became a Spanish province.

MOSQUE, a temple or place of religious worship among the Mahometans.

All mosques are square buildings, generally constructed of stone. Before the chief gate there is a square court paved with white marble; and low galleries round it, whose roof is supported by marble pillars. In these galleries the Turks wash themselves before they go into the mosque. In each mosque there is a great number of lamps; and between these hang many crystal rings, ostrich eggs, and other curiosities, which, when the lamps are lighted, make a fine show. As it it is not lawful to enter the mosque with stockings or shoes on, the pavements are covered with pieces of stuff sewed together, each being wide enough to hold a row of men kneeling, sitting, or prostrate. The women are

not

Moss. not allowed to enter the mosque, but stay in the porches without. About every mosque there are six high towers, called *minarets*, each of which has three little open galleries, one above another: these towers, as well as the mosques, are covered with lead, and adorned with gilding and other ornaments; and from thence, instead of a bell, the people are called to prayers by certain officers appointed for that purpose. Most of the mosques have a kind of hospital belonging to them, in which travellers of what religion soever, are entertained three days. Each mosque has also a place called *tarbe*, which is the burying-place of its founders; within which is a tomb six or seven feet long, covered with green velvet or satin; at the ends of which are two tapers, and round it several seats for those who read the Koran and pray for the souls of the deceased.

MOSS or MOSSES. See MUSCI, BOTANY *Index*.

Moss on Trees, in gardening. The growth of large quantities of moss on any kind of tree is a distemper of very bad consequence to its increase, and much damages the fruit of the trees of our orchards.

The present remedy is the scraping it off from the body and large branches by means of a kind of wooden knife that will not hurt the bark, or with a piece of rough hair cloth, which does very well after a soaking rain. But the most effectual cure is the taking away the cause. This is to be done by draining off all the superfluous moisture from about the roots of the trees, and may be greatly guarded against in the first planting of the trees, by not setting them too deep.

If trees stand too thick in a cold ground, they will always be covered with moss; and the best way to remedy the fault is to thin them. When the young branches of trees are covered with a long and shaggy moss, it will utterly ruin them; and there is no way to prevent it but to cut off the branches near the trunk, and even to take off the head of the tree if necessary; for it will sprout again; and if the cause be in the mean time removed by thinning the plantation, or draining the land and stirring the ground well, the young shoots will continue clear after this.

If the trees be covered with moss in consequence of the ground's being too dry, as this will happen from either extreme in the soil, then the proper remedy is the laying mud from the bottom of a pond or river pretty thick about the root, opening the ground to some distance and depth to let it in; this will not only cool it, and prevent its giving growth to any great quantity of moss, but it will also prevent the other great mischief which fruit-trees are liable to in dry grounds, which is the falling off of the fruit too early.

The mosses which cover the trunks of trees, as they always are freshest and most vigorous on the side which points to the north, if only produced on that, serve to preserve the trunk of the tree from the severity of the north winds, and direct the traveller in his way, by always plainly pointing out that part of the compass.

Moss is also a name given to boggy ground in many parts of England, otherwise called a *fen* and *bog*.

In many of these grounds, as well in England and Ireland as in other parts of the world, there are found vast numbers of trees standing with their stumps erect, and their roots piercing the ground in a natural posture as when growing. Many of those trees are broken or cut off near the roots, and lie along, and this usually in a north-east direction. People who have been willing to account for this, have usually resolved it into the effect of the deluge in the days of Noah; but this is a very wild conjecture, and is proved false by many unanswerable arguments. The waters of this deluge might indeed have washed together a great number of trees, and buried them under loads of earth; but then they would have lain irregularly and at random; whereas they all lie lengthwise from south-west to north-east, and the roots all stand in their natural perpendicular posture, as close as the roots of trees in a forest. Moss

Besides, these trees are not all in their natural state, but many of them have the evident marks of human workmanship upon them, some being cut down with an axe, some split, and the wedges still remaining in them; some burnt in different parts, and some bored through with holes. These things are also proved to be of a later date than the deluge, by other matters found among them, such as utensils of ancient people, and coins of the Roman emperors.

It appears from the whole, that all the trees which we find in this fossil state, originally grew in the very places where we now find them, and have only been thrown down and buried there, not brought from elsewhere. It may appear indeed an objection to this opinion, that most of these fossil trees are of the fir kind; and that Cæsar says expressly, that no firs grew in Britain in his time; but this is easily answered, by observing, that these trees, though of the fir kind, yet are not the species usually called the *fir*, but pitch-tree; and Cæsar has no where said that pitch-trees did not grow in England. Norway and Sweden yet abound with these trees; and there are at this time whole forests of them in many parts of Scotland, and a large number of them wild upon a hill at Warcton in Staffordshire to this day.

In Hatfield marsh, where such vast numbers of the fossil trees are now found, there has evidently once been a whole forest of them growing. The last of these was found alive, and growing in that place within 70 years last past, and cut down for some common use.

It is also objected by some to the system of the firs growing where they are found fossil, that these countries are all bogs and moors, whereas these sorts of trees grow only in mountainous places. But this is founded on an error; for though in Norway and Sweden, and some other cold countries, the fir kinds all grow upon barren and dry rocky mountains, yet in warmer places they are found to thrive as well on wet plains. Such are found plentifully in Pomerania, Livonia, and Courland, &c. and in the west parts of New England there are vast numbers of fine stately trees of them in low grounds. The whole truth seems to be, that these trees love a sandy soil; and such as is found at the bottoms of all the mosses where these trees are found fossil. The roots of the fir kind are always found fixed in these; and those of oaks, where they are found fossil in this manner, are usually found fixed in clay; so that each kind of tree is always found rooted in the places where they stand in their proper soil; and there is no doubt to be made but that they ori-

Moss. ginally grew there. When we have thus found that all the fossil trees we meet with once grew in the places where they are now buried, it is plain that in these places there were once noble forests, which have been destroyed at some time; and the question only remains how and by whom they were destroyed. This we have reason to believe, by the Roman coins found among them, was done by the people of that empire, and that at the time when they were established or establishing themselves here.

Their own historians tell us, that when their armies pursued the wild Britons, these people always sheltered themselves in the miry woods and low watery forests. Cæsar expressly says this; and observes, that Cassibelanus and his Britons, after their defeat, passed the Thames, and fled into such low morasses and woods, that there was no pursuing them: and we find that the Silures secured themselves in the same manner when attacked by Ostorius and Agricola. The same thing is recorded of Venutius king of the Brigantes, who fled to secure himself into the boggy forests of the midland part of this kingdom: and Herodian expressly says, that in the time of the Romans pushing their conquests in these islands, it was the custom of the Britons to secure themselves in the thick forests which grew in their boggy and wet places, and when opportunity offered, to issue out thence and fall upon the Romans. The consequence of all this was the destroying all these forests; the Romans finding themselves so plagued with parties of the natives issuing out upon them at times from these forests, that they gave orders for the cutting down and destroying all the forests in Britain which grew on boggy and wet grounds. These orders were punctually executed; and to this it is owing that at this day we can hardly be brought to believe that such forests ever grew with us as are now found buried.

The Roman historians all agree, that when Suetonius Paulinus conquered Anglesea, he ordered all the woods to be cut down there, in the manner of the Roman generals in England: and Galen tells us, that the Romans, after their conquest in Britain, kept their soldiers constantly employed in cutting down forests, draining of marshes, and paving of bogs. Not only the Roman soldiers were employed in this manner, but all the native Britons made captives in the wars were obliged to assist in it: and Dion Cassius tells us, that the emperor Severus lost no less than 50,000 men in a few years time in cutting down the woods and draining the bogs of this island. It is not to be wondered at, that such numbers executed the immense destruction which we find in these buried forests. One of the greatest subterranean treasures of wood is that near Hatfield; and it is easy to prove, that these people, to whom this havock is thus attributed, were upon the spot where these trees now lie buried. The common road of the Romans out of the south into the north, was formerly from Lindum (Lincoln), to Segelochum (Little Burrow upon Trent), and from thence to Danum (Doncaster), where they kept a standing garrison of Crispinian horse. A little off on the east, and north-east of their road, between the two last-named towns, lay the borders of the greatest forest, which swarmed with wild Britons, who were continually making their sallies out, and their retreats into it again, intercepting their provisions, taking and destroying their carriages, killing their allies and passengers, and disturbing their garrisons. This at length so exasperated the Romans, that they were determined to destroy it; and to do this safely and effectually, they marched against it with a great army, and encamped on a great moor not far from Finningly; this is evident from their fortifications yet remaining. Moss.

There is a small town in the neighbourhood called *Osterfield;* and as the termination *field* seems to have been given only in remembrance of battles fought near the towns whose names ended with it, it is not improbable that a battle was fought here between all the Britons who inhabited this forest and the Roman troops under Ostorius. The Romans slew many of the Britons, and drove the rest back into this forest, which at that time overspread all this low country. On this the conquerors taking advantage of a strong south-west wind, set fire to the pitch-trees, of which this forest was principally composed; and when the greater part of the trees were thus destroyed, the Roman soldiers and captive Britons cut down the remainder, except a few large ones which they left standing as remembrances of the destruction of the rest. These single trees, however, could not stand long against the winds, and these falling into the rivers which run through the country, interrupted their currents; and the water then overspreading the level country, made one great lake, and gave origin to the mosses or moory bogs, which were afterwards formed there, by the workings of the waters, the precipitation of earthy matter from them, and the putrefaction of rotten boughs and branches of trees, and the vast increase of water-moss and other such plants which grow in prodigious abundance in all these sorts of places. Thus were these burnt and felled trees buried under a new-formed spongy and watery earth, and afterwards found on the draining and digging through this earth again.

Hence it is not strange that Roman weapons and Roman coins are found among these buried trees; and hence it is that among the buried trees some are found burnt, some chopped and hewn; and hence it is that the bodies of the trees all lie by their proper roots, and with their tops lying north-east, that is, in that direction in which a south-west wind would have blown them down: hence also it is, that some of the trees are found with their roots lying flat, these being not cut or burned down, but blown up by the roots afterwards when left single; and it is not wonderful, that such trees as these should have continued to grow even after their fall, and shoot up branches from their sides which might easily grow into high trees. Phil. Trans. N° 275.

By this system it is also easily explained why the moor soil in the country is in some places two or three yards thicker than in others, or higher than it was formerly, since the growing up of peat-earth or bog-ground is well known, and the soil added by overflowing of waters is not a little.

As the Romans were the destroyers of this great and noble forest, so they were probably also of the several other ancient forests; the ruins of which furnish us with the bog-wood of Staffordshire, Lancashire, Yorkshire, and other counties. But as the Romans were not much in Wales, in the Isle of Man, or in

Moss. in Ireland, it is not to be supposed that forests cut down by these people gave origin to the fossil wood found there; but though they did not cut down these forests, others did; and the origin of the bog-wood is the same with them and with us. Holingshed informs us, that Edward I. being not able to get at the Welsh because of their hiding themselves in boggy woods, gave orders at length that they should all be destroyed by fire and by the axe; and doubtless the roots and bodies of trees found in Pembrokeshire under ground, are the remains of the execution of this order. The fossil wood in the bogs of the island of Man is doubtless of the same origin, though we have not any account extant of the time or occasion of the forests there being destroyed; but as to the fossil trees of the bogs of Ireland, we are expressly told that Henry II. when he conquered that country, ordered all the woods to be cut down that grew in the low parts of it, to secure his conquests, by cutting away the places of resort of rebels. For a fuller detail of the natural history of mosses, see Essays on this subject by the Rev. Mr Rennie of Kilsyth.

Moving-MOSS. We have an account in the Philosophical Transactions of a moving moss near Churchtown in Lancashire, which greatly alarmed the neighbourhood as miraculous. The moss was observed to rise to a surprising height, and soon after sunk as much below the level, and moved slowly towards the south.

A very surprising instance of a moving moss is that of Solway in Scotland, which happened in the year 1771, after severe rains which had produced terrible inundations of the rivers in many places. For the better understanding of this event, we shall give the following description of the spot of ground where it happened. Along the side of the river Esk there is a vale, about a mile broad, less or more in different places. It is bounded on the south-east by the river Esk, and on the north-west by a steep bank 30 feet in height above the level of the vale. From the top of the bank the ground rises in an easy ascent for about a quarter of a mile, where it is terminated by the moss; which extends about two miles north and south, and about a mile and a half east and west, and is bounded on the north-west by the river Sark. It is probable that the solid ground from the top of the bank above the vale was continued in the same direction under the moss, before its eruption, for a considerable space; for the moss at the place where the eruption happened, was inclined towards the sloping ground. From the edge of the moss there was a gully or hollow, called by the country people *the gap*, and said to be 30 yards deep where it entered the vale; down which ran a small rill of water, which was often dry in summer, having no supply but what filtered from the moss. The eruption happened at the head of this gap, on Saturday November 16. 1771, about ten or eleven at night, when all the neighbouring rivers and brooks were prodigiously swelled by the rains. A large body of the moss was forced, partly by the great fall of rain, and partly by some springs below it, into a small beck or burn, which runs within a few yards of its border to the south east. By the united pressure of the water behind it, and of this beck, which was then very high, it was carried down a narrow glen between two banks about 300 feet high, into a wide and spacious plain, over part of which it spread with great rapidity. The moss continued for some time to send off considerable quantities; which being borne along by the torrent on the back of the first great body, kept it for many hours in perpetual motion, and drove it still farther on. This night at least 400 acres of fine arable land were covered with moss from 3 to 12 or 15 feet deep. Several houses were destroyed, a good deal of corn lost, &c. but all the inhabitants escaped. When the waters subsided, the moss also ceased to flow; but two pretty considerable streams continued to run from the heart of it, and carried off some pieces of mossy matter to the place where it burst. There they joined the beck already mentioned; which, with this addition, resumed its former channel; and, with a little assistance from the people of the neighbourhood, made its way to the Esk, through the midst of that great body of moss which obstructed its course. Thus, in a great measure drained, the new moss fell several feet, when the fair weather came in the end of November, and settled in a firmer and more solid body on the lands it had overrun. By this inundation about 800 acres of arable ground were overflowed before the moss stopped, and the habitations of 27 families destroyed. Tradition has preserved the memory of a similar inundation in Monteith in Scotland. A moss there altered its course in one night, and covered a great extent of ground.

Moss || Motion

Moss Troopers, a rebellious sort of people in the north of England, who lived by robbery and rapine, not unlike the tories in Ireland, the bucaniers in Jamaica, or banditti of Italy. The counties of Northumberland and Cumberland were formerly charged with a yearly sum, and a command of men, to be appointed by justices of the peace, to apprehend and suppress them.

MOSTRA, in the Italian music, a mark at the end of a line or space, to show that the first note of the next line is in that place: and if this note be accompanied with a sharp or flat, it is proper to place these characters along with the mostra.

MOSUL, or Mousul. See Mousul.

MOTACILLA, the Wagtail and Warbler; a genus of birds of the order of passeres. See Ornithology *Index*.

MOTE, in law books, signifies court or convention; as ward mote, burgh mote, swain mote, &c.

Mote was also used for a fortress or castle; as *mota de Windsor*, &c.

Mote also denoted a standing water to keep fish in; and sometimes a large ditch encompassing a castle or dwelling house.

Mote-Bell, or *Mot-bell*, the bell so called, which was used by the English Saxons to call people together to the court. See Folkmote.

MOTH. See Phalæna, Entomology *Index*.

MOTHER, a term of relation, denoting a woman who hath born a child.

Mother-of-Pearl. See Mytilus, Conchology *Index*.

MOTION is now generally considered as incapable of definition, being a simple idea or notion received by the senses. The ancients, however, thought differently. Some of them defined it to be a passage out of one *state* into another; which conveys no idea to him

Motion

Motion.

who is ignorant of the nature of motion.—The Peripatetic definition has been mentioned elsewhere and shown to be wholly unintelligible, as well as their celebrated division of motion into four classes, belonging to the three categories, *quality*, *quantity*, and *where*; (see METAPHYSICS, N° 188, 189, 190). The Cartesians, too, among the moderns, pretend to define motion, by calling it a passage or removal of one part of matter, out of the neighbourhood of those parts to which it is immediately contiguous, into the neighbourhood of others. Borelli defines motion to be the successive passage of a body from place to place. Others say that it is the application of a body to different parts of infinite and immoveable space; and a late writer * of uncommon acuteness has given as a definition of motion—*change of place*.

2 Several definitions of.

* See *An Essay on the Powers and Mechanism of Nature*, by Robert Young.

We have elsewhere offered our opinion of every possible attempt to define motion: but as the author of the last quoted definition has endeavoured to obviate such objections as ours, candour requires that he be heard for himself. "It is said (he observes) by some, that change implies motion, and therefore cannot be a part of its definition, being the very thing defined To this I answer, We are speaking of the sensible idea of motion, as it appears to our sight; now changes do appear to our view, and to all our senses, which give us no idea of motion. Changes in heat or cold; in colour, flavour, smell, sound, hardness, softness, pain, pleasure; in these, and many other ideas, changes do not produce ideas like that produced by a ball rolling or a stone falling. We may perhaps ultimately trace them to motion, but to insensible motions; to motions which arise only in reflection, and constitute no part of the actual idea of change. We can therefore conceive of change, without conceiving at the same time of motion.—Change is a generic idea, including many species; motion, as a sensible idea, is a species of that genus. Change is therefore a necessary part of the definition of motion; it marks the genus of the thing defined. Motion is a change; but as there are many species of change, which of those species is motion? The answer is, It is a change of place. This marks the species; and distinguishes it from change of colour, of temperament and figure."

This is the ablest defence of an attempt to define motion that we have ever seen; and at first view the definition itself appears to be perfect. Aristotle, the prince of definers, "considers a definition† as a speech declaring what a thing is. Every thing essential to the thing defined, and nothing more, must be contained in the definition. Now the essence of a thing consists of these two parts: first, what is *common* to it with other things of the same kind; and secondly, what *distinguishes* it from other things of the same kind. The first is called the *genus* of the thing; the second, its *specific difference*. The definition, therefore, consists of these two parts."

† See Dr Reid's account of Aristotle's logic, in Lord Kames's *Sketches of Man*.

3 Shown not to declare what the thing is; and therefore to be no definition.

In obedience to this rule, the definition under consideration seems to consist of the *genus*, signified by the word *change*; and of the *specific difference*, denoted by the words *of place*. But does the speech *change of place* really declare what motion is? We cannot admit that it does; as, in our apprehension, a *change of place* is the *effect* of motion, and not *motion itself*. Suppose a lover of dialectic undertaking to define the stroke by which he saw his neighbour wounded with a bludgeon; what should we think of his art were he to call it a contusion on the head? He might say that *contusion* is a general term, as contusions may be produced on the arms, on the legs, and on various parts of the body; and as there are many species of contusion, if he were asked which of those species was the stroke to be defined, he might answer, "a contusion on the head." Here would be apparently the *genus* and *specific difference*; the former denoted by *contusion*, and the latter by the words *on the head*. But would this be a definition of a stroke? No, surely: a contusion on the head may be the *effect* of a stroke; but it can no more be the *stroke itself*, than a blow can be a bludgeon, or a flesh wound the point of a sword. Equally evident it is, that a change of place cannot be motion; because every body must have been actually moved before we can discern, or even conceive, a change of its place.

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The *act of changing the place* would perhaps come nearer to a definition of motion; but so far would it be from "a speech declaring what motion is," that we are confident a man who had never by any of his senses perceived a body in actual motion, would acquire no ideas whatever from the words "act of changing place." He might have experienced changes in heat, cold, smell, and sound; but he could not possibly combine the ideas of such changes with the signification of the word *place*, were he even capable of understanding that word, which to us appears to be more than doubtful. (See METAPHYSICS, N° 40, 41.).

4 The distinctions of motion into different kinds insignificant.

The distinctions of motion into different kinds have been no less various, and no less insignificant, than the several definitions of it. The moderns who reject the Peripatetic division of motion into four classes, yet consider it themselves as either *absolute* or *relative*. Thus we are told, that "*absolute motion* is the change of absolute *place*, and that its celerity must be measured by the quantity of *absolute space* which the moving body runs through in a given time." "*Relative motion*, on the other hand, is a mutation of the *relative* or *vulgar place* of the moving body, and has its celerity estimated by the quantity of *relative space* run through."

Now it is obvious, that this distinction conveys no ideas without a farther explanation of the terms by which it is expressed; but that explanation is impossible to be given. Thus, before we can understand what *absolute motion* is, we must understand what is meant by *absolute place*. But absolute place is a contradiction; for all *place* is *relative*, and consists in the positions of different bodies with regard to one another. Were a globe in the regions of empty space to be put in motion by Almighty Power, and all the rest of the corporeal world to be soon afterwards annihilated, the motion would undoubtedly continue unchanged; and yet, according to this distinction, it would be at first *relative*, and afterwards *absolute*. That the beginning of such a motion would be *perceptible*, and the remainder of it *imperceptible*, is readily granted; but on this account to consider it as of two kinds, is as absurd as to suppose the motion of the minute hand of a clock to be affected by our looking at it.

5 The opinions of the Cartesians and of Newton respecting the source of motion.

Leaving therefore these unintelligible distinctions, we now come to consider a question still of a very abstruse nature, but much agitated among philosophers, viz.

Motion. viz. What is the original source of motion in the creation: Is it natural to matter? or are we to ascribe it to the immediate and continual agency of some *immaterial* being? The former has been strenuously argued by the Cartesians, and the latter by the Newtonians. The arguments of the former, founded upon the chimerical hypothesis of vortices and the original construction of matter, were evidently inconclusive; and the hypothesis of Sir Isaac Newton, who asserted that it was naturally *incapable* of motion, appeared more probable. To account for the quantity of motion in the universe, therefore, it became necessary to have recourse either to the Deity, or to some subordinate spiritual agent; and this became the more necessary, as the doctrine of an absolute vacuum in the celestial spaces, that is, throughout the incomparably greatest part of the creation, was one of the fundamental maxims of the system. As it was absolutely denied that matter existed in these spaces, and it was plain that the celestial bodies affected one another at immense distances, the powers of attraction and repulsion were naturally called in as the sources of motion by their impulse upon inert and sluggish matter. These being admitted, a speculation ensued concerning their nature. *Spiritual*, it was confessed, they were; but whether they were to be accounted the immediate action of the divine Spirit himself, or that of some subordinate and inferior spirit, was a matter of no little dispute. Sir Isaac Newton, towards the latter part of his life, began to relax somewhat of the rigidity of his former doctrine; and allowed that a very subtle medium, which he called *æther*, might be the cause of attraction and repulsion, and thus of the whole phenomena of nature. Since his time the multitude of discoveries in electricity, the similarity of that fluid to fire and light, with the vast influence it has on every part of the creation with which we are acquainted, have rendered it very probable that the æther mentioned by Sir Isaac is no other than the element of fire, "the most subtle † and elastic of all bodies, which seems to pervade and expand itself throughout the whole universe. Electrical experiments show that this mighty agent is everywhere present, ready to break forth into action, if not restrained and governed with the greatest wisdom. Being always restless and in motion, it actuates and enlivens the whole visible mass; is equally fitted to produce and to destroy; distinguishes the various stages of nature, and keeps up the perpetual round of generations and corruptions, pregnant with forms which it constantly sends forth and resorbs. So quick in its motions, so subtle and penetrating in its nature, so extensive in its effects, it seemeth no other than the vegetative soul or vital spirit of the world.

6 A subtle æther the probable cause of attraction and repulsion.

† *Siris*, N° 153, &c.

7 The opinions of the ancients on this subject.

"The animal spirit in man is the instrument both of sense and motion. To suppose sense in the corporeal world would be gross and unwarranted; but locomotive faculties are evident in all its parts. The Pythagoreans, Platonists, and Stoics, held the world to be an animal; though some of them have chosen to consider it as a vegetable. However, the phenomena do plainly show, that there is a spirit that moves, and a mind or providence that presides. This providence, Plutarch saith, was thought to be in regard to the world what the soul is in regard to man. The order and course of things, and the experiments we daily make, show that there is a mind which governs and actuates this mundane system as the proper and real agent and cause; and that the inferior instrumental cause is pure æther, fire, or the substance of light, which is applied and determined by an infinite mind in the macrocosm or universe, with unlimited power, and according to stated rules, as it is in the microcosm with limited power and skill by the human mind. We have no proof either from experiment or reason of any other agent or efficient cause than the mind or spirit. When, therefore, we speak of corporeal agents or corporeal causes, this is to be understood in a different, subordinate, and improper sense; and such an agent we know light or elementary fire to be." Motion.

8 Experiments proving that a subtle æther may be the immediate cause of the planetary motions, &c.

That this elementary fire, absorbed and fixed in all bodies, *may* be the cause of the universal principle of gravity, is made sufficiently evident by numberless experiments. Homberg having calcined in the focus of a burning glass some regulus of antimony, found that it had gained one-tenth in weight, though the regulus, during the whole time of the operation, sent up a thick smoke, and thereby lost a considerable part of its own substance. It is vain to allege that any heterogeneous matter floating in the air, or that the air itself, may have been hurried into the mass by the action of the fire, and that by this additional matter the weight was increased; for it is known experimentally, that if a quantity of metal be even hermetically secured within a vessel of glass to keep off the air and all foreign matter, and the vessel be placed for some time in a strong fire, it will exhibit the same effect. "I have seen the operation performed (says Mr Jones †) on two ounces of pewter filings, hermetically sealed up in a Florence flask, which in two hours gained 55 grains, that is nearly one 17th. Had it remained longer in the fire, it might probably have gained something more; as, in one of Mr Boyle's experiments, steel filings were found to have gained a fourth.

† *Essay on the First Principles of Natural Philosophy.*

"Of accounting for these effects there are but two possible ways: 1. If the quantity of matter be the same, or, in the case of calcination, be somewhat less, after being exposed to the action of the fire, while the gravity of the whole is become greater; then does it follow, that gravity is not according to the quantity of matter, and of course is not one of its properties. 2. If there be an increase of the mass, it can be imputed to nothing but the matter of light or fire entangled in its passage through the substance, and so fixed in its pores, or combined with its solid parts, as to gravitate together with it. Yet it is certain, from the phenomenon of light darting from the sun, that this elementary fire does not gravitate till it is fixed in metal, or some other solid substance.—Here then we have a fluid which gravitates, if it gravitate at all, in some cases and not in others. So that which way soever the experiment be interpreted, we are forced to conclude that elementary or solar fire may be the cause of the law of gravitation."

That it is likewise in many cases the cause of repulsion, is known to every one who has seen it fuse metals, and convert water and mercury into elastic vapour. But there is a fact recorded by Mr Jones, which seems to evince that the same fluid, which as it issues from the sun exhibits itself in the form of light and heat, is in other circumstances converted into a very fine air,

or

Motion. or cold æther, which rushes very forcibly towards the body of that luminary. "As a sequel to what has been observed (says he) concerning the impregnation of solid substances with the particles of fire, give me leave to subjoin an experiment of M. de Stair. He tells us, that upon heating red lead in a glass whence the air was exhausted by the rays of the sun collected in a burning glass, the vessel in which the said red lead was contained burst in pieces with a great noise. Now, as all explosions in general must be ascribed either to an admission of the air into a rarefied space, or to what is called the *generation* of it; and as air was not admitted upon this occasion, it must have been generated from the calx within the vessel; and certainly was so, because Dr Hales has made it appear that this substance, like crude tartar and many others, will yield a considerable quantity of *air* in distillation. What went into the metal therefore as *fire*, came out of it again as *air;* which in a manner forces upon us conclusions of inestimable value in natural philosophy, and such as may carry us very far into the most sublime part of it."

One of the conclusions which the ingenious author thinks thus forced upon us, is, that the motion of the planets round the sun, as well as round their own axes, is to be attributed to the continual agency of this fluid, under its two forms of elementary fire and pure air. As fire and light, we know that it rushes with inconceivable rapidity from the body of the sun, and penetrates every corporeal substance, exerting itself sometimes with such force as nothing with which we are acquainted is able to resist. If it be indeed a fact, that this elementary fire, or principle of light and heat, afterwards cools, and becomes pure air, there cannot be a doubt, but that under such a form it will return with great force, though surely in a somewhat different direction, towards the sun, forming a vortex, in which the planets are included, and by which they must of course be carried round the centre. Mr Jones does not suppose that the air into which the principle of light and heat is converted, is of so gross a nature as our atmosphere. He rather considers it as cool æther, just as he represents light to be æther heated: but he maintains, that this æther, in its aërial form, though not fit for human respiration, is a better *pabulum* of fire than the air which we breathe.

This theory is exceedingly plausible; and the author supports it by many experiments. He has not, indeed, convinced us that the solar light is converted or convertible into pure air; but he has, by just reasoning from undoubted facts, proved that the whole expanse of heaven, as far as comets wander, is filled not only with light, which is indeed obvious to the senses, but also with a fluid, which, whatever it may be called, supplies the place of the air in feeding the fire of these ignited bodies.

9 The existence of such an æther, however, does not completely solve the phenomena.

That the motion of the heavenly bodies should result from the perpetual agency of such a medium, appears to us a much more rational hypothesis, than that which makes them act upon each other at immense distances through empty space, But the hypothesis is by no means so complete a solution of the phenomena as some of its fond admirers pretend to think it. This fluid, whether called æther, heat, light, or air, is still material; and the question returns upon him who imagines that it is sufficient to account for gravitation, repulsion, magnetism, and cohesion, &c. "What moves the fluid itself, and makes the parts of which it is composed cohere together?" However widely it may be extended, it is incapable of positive infinity; and therefore *may be* divided into parts separated from each other; so that it must be held together by a foreign force, as well as a ball of lead, or a piece of wax. As matter is not essentially active, the motion of this æther, under both its forms, must likewise be considered as an effect, for which we do not think that any propelling power in the body of the sun can be admitted as a sufficient cause. For how comes the sun to possess that power, and what makes the fluid return to the sun? We have no notion of power, in the proper sense of the word, but as intelligence and volition; and, by the pious and excellent author of the Essay on the First Principles of Natural Philosophy, we are certain that the sun was never supposed to be intelligent.

10 It is therefore by some supposed to be animated. * *Siris*, N° 277.

Bishop Berkeley, who admits of light or æther as the instrumental cause of all corporeal motion, gets rid of this difficulty, by supposing, with the ancients, that this powerful agent is animated. "According to the Pythagoreans and Platonists (says his Lordship *), there is a life infused throughout all things; the πυρ νοερον, πυρ τεχνικον, an intellectual and artificial fire, an inward principle, animal spirit, or natural life, producing and forming within, as art doth without; regulating, moderating, and reconciling the various motions, qualities, and parts of the mundane system. By virtue of this life, the great masses are held together in their ordinary courses, as well as the minutest particles governed in their natural motions, according to the several laws of attraction, gravity, electricity, magnetism, and the rest. It is this gives instincts, teaches the spider her web, and the bee her honey. This it is that directs the roots of plants to draw forth juices from the earth, and the leaves and cortical vessels to separate and attract such particles of air and elementary fire as suit their respective natures."

This life or animal spirit seems to be the same thing which Cudworth calls plastic nature, and which has been considered elsewhere. (See METAPHYSICS, N° 200, and *PLASTIC Nature*). We shall therefore dismiss it at present, with just admitting the truth of the bishop's position, "that if nature be supposed the life of the world, animated by one soul, compacted into one frame, and directed or governed in all its parts by one supreme and distinct intelligence, this system cannot be accused of atheism, though perhaps it may of mistake or impropriety."

11 A new theory of motion,

A theory of motion somewhat similar to that of Berkeley, though in several respects different from it, was not many years ago stated with great clearness, and supported with much ingenuity, in An Essay on the Powers and Mechanism of Nature, intended to improve, and more firmly establish, the grand superstructure of the Newtonian system. Mr Young, the author of the essay, admits with most other philosophers of the present age, that body is composed of atoms which are impenetrable to each other, and may be denominated solid. These atoms, however, he does not consider as primary and simple elements, incapable of resolution into principles;

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ciples; but thinks that they are formed by certain motions of the parts of a substance immaterial and essentially active.

12 by supposing that a substance essentially active pervades the universe.

As this notion is uncommon, and the offspring of a vigorous mind, we shall consider it more attentively under the article *Plastic Nature*. It is mentioned at present as a necessary introduction to the author's theory of motion, of which he attributes both the origin and the continuance to the agency of this elementary substance pervading the most solid atoms of the densest bodies. Of every body and every atom he holds the constituent principles to be essentially active: but those principles act in such a manner as to conterbalance each other; so that the atom or body considered as a whole is inert, unless in so far as it resists the compression or separation of its parts. No body or atom can of itself begin to move, or continue in motion for a single instant: but being pervious to the active substance, and coalescing with it, that substance, when it enters any body, it carries it along with it, till, meeting some other body in the way, either the whole of the active substance lodged in the former body passes into the obstacle, in which case the impelling body instantly ceases to move: or else part of that substance passes into the obstacle, and part remains in the impelling body; and in this case both bodies are moved with a velocity in proportion to the quantity of matter which each contains, combined with the quantity of active substance by which they are respectively penetrated.

13 Proofs of the existence of such a substance.

In order to pave the way for his proof of the existence of one uniform active substance, he observes, that "*change* being an essentially constituent part of motion, and change implying action, it follows that *all motion implies action, and depends on an active cause.* Every motion (he continues) has a beginning, a middle, and an end. The beginning is a change from rest to motion; the middle is a continuance in motion; the end is a change from motion to rest." He then proceeds to show, that the beginning of motion is by an action begun; the continuance of motion by an action continued; and the end of motion by a cessation of action.

"The first of these positions is admitted by every body. That the *continuance* of motion is by an action *continued*, will be proved, if it shall be shown that the continuance of a motion is nothing different from its beginning, in regard to any point of time assumed in the continued motion. Now the beginning of motion (he says) consists in the beginning of change of place. But if any given portions of time and of space are assumed, a body beginning to move in the commencement of that time, and in the first portion of the space assumed, then and there begins that particular motion: and whether before the body began to move in that space it was moving in other spaces and times, has no relation to the motion in question; for this being in a space and time altogether distinct, is a distinct motion from any which might have preceded it immediately, as much as from a motion which preceded it a thousand years before. It is therefore a new motion begun; and so it may be said of every assumable point in the continued motion. The term *continued* serves only to connect any two distinct motions, the end of one with the beginning of the other; but does not destroy their distinctness."

He then proceeds to combat, which he does very successfully, the arguments by which the more rigid Newtonians endeavour to prove that a body in motion will continue to be moved by its own *inertia*, till stopt by some opposite force. Having done this, he establishes the contrary conclusion by the following syllogisms: Motion

"I. Whatever requires an active force to stop its motion, is disposed to move.
Every body in motion requires an active force to stop its motion:
Therefore every body in motion is disposed to move.

"II. Whatever is disposed to motion is possessed of action.
But a body in motion is disposed to continue in motion:
Therefore a body in motion is possessed of action.

Thus it appears, that the middle part of any motion is action equally with the beginning.

"The last part of motion is its *termination*. It is admitted that all motion is terminated by an action contrary to the direction of the motion. It is admitted, too, that the moving body *acts* at the time its motion is destroyed. Thus the *beginning* and the *end* of any uniform motion are confessed to be actions; but all the intermediate *continuation* which connects the beginning with the end is denied to be action. What can be more unaccountable than this denial? Is it not more consonant to reason and analogy, to ascribe to the whole continued motion one uninterrupted action? Such a conclusion true philosophy, we think, requires us to make.

"To move or act, is an attribute which cannot be conceived to exist without a substance. The *action of a body in motion* is indeed the attribute of the body, and the body relatively to its own motion is truly a substance, having the attribute or quality of motion. But the body being a name signifying a combination of certain ideas, which ideas are found to arise from action (see *Plastic Nature*), that action which is productive of those ideas whose combination we denominate body, is of the nature of an attribute so long as it is considered as constituted of action.—To this attribute we must necessarily assign its substance. The actions which constitute body must be actions of something, or there must be something which acts. When then is this ACTIVE SOMETHING, from whose agency we get the idea of body, or whose actions constitute body? Is it not sufficient that it is something active? A name might be surely given it, but a name would not render the idea more clear. Its description may be found in every sensation; it is colour to the eye, flavour to the palate, odour to the nose, sound to the ear, and feeling to the touch; for all our sensations are but so many ways in which this ACTIVE SOMETHING is manifested to us. A substratum of solidity philosophers have imagined to exist, and have in vain sought to find. Our ACTIVE SUBSTANCE is the substratum so long sought for, and with so little success. We give it a quality by which it may be perceived; it ACTS. One modification of *action* produces MATTER, another generates MOTION. These modifications of action are modes of the active substance, whose presence is action: matter and motion

constitute

Motion. constitute the whole of nature. THERE IS THEREFORE THROUGHOUT NATURE AN ACTIVE SUBSTANCE, THE CONSTITUENT ESSENCE OF MATTER, AND IMMEDIATE NATURAL AGENT IN ALL EFFECTS."

14 Which is unintelligent,

By an argument which we do not think very conclusive, our author determines this active substance to be unintelligent. "In our sensations individually, not discovering (says he) the traces, not seeing the characters of intelligence, but finding only action present and necessary, our inferences go no farther than our observations warrant us to do; and we conclude in all these things an action only, and that action unintelligent." Having given our opinion of real agency elsewhere (see METAPHYSICS, N° 118.), we shall not here stop to examine this reasoning.—We may however ask, Whether all our sensations individually be not excited for a *certain end*? If they be, according to our author's mode of arguing in another place, the exciting agent should be an intelligent being. By this we are far from meaning to deny the reality of a secondary or instrumental cause of sensation which is destitute of intelligence. We are strongly inclined to think that there is such a cause, though our persuasion results not from this argument of our author's. In our opinion, he reasons better when he says, "that a subordinate agent constructed as the matter of creation, invested with perpetual laws, and producing agreeably to those laws all the forms of being, through the varieties of which inferior intelligences can, by progressive steps, arrive ultimately at the supreme contriver, is more agreeable to our ideas of dignity, and tends to impress us with more exalted sentiments, than viewing the Diety directly in all the individual impressions we receive, divided in the infinity of particular events, and unawful, by his continual presence in operations to our view insignificant and mean."

15 and neither matter nor mind.

This active substance, or secondary cause, our author concludes to be neither matter nor mind. "Matter (says he) is a being, as a whole quiescent and inactive, but constituted of active parts, which resist separation, or cohere, giving what is usually denominated solidity to the mass. Mind is a substance which thinks. A being which should answer to neither of these definitions, would be neither matter nor mind; but an *immaterial*, and, if I may so say, an *immental* substance." Such is the active substance of Mr Young, which, considered as the cause of motion, seems not to differ greatly from the *plastic nature*, *hylarchical principle*, or *vis genitrix*, of others. The manner in which it operates is indeed much more minutely detailed by our author than by any other philosopher, ancient or modern, with whose writings we have any acquaintance.

"Every thing (he says) must be in its own nature either disposed to rest or motion; consequently the ACTIVE SUBSTANCE must be considered as a being naturally either quiescent or motive. But it cannot be naturally quiescent; for then it could not be active, because activity, which is a tendency to motion, cannot originate in a tendency to rest. Therefore the ACTIVE SUBSTANCE is by nature motive, that is, tending to motion. The ACTIVE SUBSTANCE is not solid, and does not resist penetration. It is, therefore, incapable of impelling or of sustaining impulse. Whence it follows, that as it tends to move, and is incapable of having its motion impeded by impulse, it must actually and continually move: in other words, MOTION IS ESSENTIAL TO THE ACTIVE SUBSTANCE. Motion.

16 The manner in which it is supposed to operate.

"In order that this substance may *act*, some other thing upon which it may produce a change is necessary; for whatever suffers an action, receives some change. The active substance, in acting on some other thing, must impart and unite itself thereto; for its *action* is communicating its *activity*. But it cannot communicate its activity without imparting its substance: because it is the substance alone which possesses activity, and the quality cannot be separated from the substance. THEREFORE THE ACTIVE SUBSTANCE ACTS BY UNITING ITSELF WITH THE SUBSTANCE ON WHICH IT ACTS. The union of this substance with bodies, is not to be conceived of as a junction of small parts intimately blended together and attached at their surfaces; but as an entire diffusion and incorporation of one substance with another in perfect coalescence. As bodies are not naturally active, whenever they become so, as they always do in motion, it must be by the accession of some part of the active substance. The active substance being imparted to a body, penetrates the most solid or resisting parts, and does not reside in the pores without, and at the surfaces of the solid parts. For the activity is imparted to the body itself; and not to its pores, which are no parts of the body: therefore if the active substance remained within the pores, the cause would not be present with its effect; but the cause would be in one place and the effect in another, which is impossible.

"Bodies by their impulse on others lose their activity in proportion to the impulse. This is matter of observation. Bodies which suffer impulse acquire activity in proportion to the impulse. This also is matter of observation. In impulse, therefore, the active substance passes out of the impelling body into the body impelled. For since bodies in motion are active, and activity consists in the presence of the active substance, and by impulse bodies lose their activity, therefore they lose their active substance, and the loss is proportional to the impulse. Bodies impelled acquire activity; therefore acquire active substance, and the acquisition is proportioned to the impulse. But the active substance lost by the impelling body ought to be concluded to be that found in the other; because there is no other receptacle than the impelled body to which the substance parted from can be traced, nor any other source than the active body whence that which is found can be derived. Therefore, in impulse, the active substance ought to be concluded to pass from the impelling body to the body impelled. The flowing of such a substance is a sufficient cause of the communication of activity, and no other rational cause can be assigned.

"The continued motion of a body depends not upon its *inertia*, but upon the continuance of the active substance within the body. The motion of a body is produced by the motion of the active substance in union with the body. It being evident, that since the active substance itself does always move, whatever it is united to will be moved along with it, if no obstacle prevent. In mere motion, the body moved is the patient, and the active substance the agent. In impulse,

Motion. impulse, the body in motion may be considered as an agent, as it is made active by its active substance.—While the active substance is flowing out of the active body into the obstacle or impelled body, the active body will press or impel the obstacle. For while the active substance is yet within the body, although flowing through it, it does not cease to impart to the body its own nature, nor can the body cease to be active because not yet deprived of the active substance. Therefore during its passing out of the body, such portion of the active substance as is yet within, is urging and disposing the body to move, in like manner as if the active substance were continuing in the body; and the body being thus urged to move, but impeded from moving, presses or impels the obstacle.

17 produces impulse,

"We see here (says our author) an obvious explanation of impulse; it consists in the flowing of the motive substance from a source into a receptacle;" and he thinks, that although the existence of such a substance had not been established on any previous grounds, the communication of motion by impulse does alone afford a sufficient proof of its reality.

He employs the agency of the same substance to account for many other apparent activities in bodies, such as those of *fire*, *electricity*, *attraction*, *repulsion*, *elasticity*, &c. All the apparent origins of corporeal activity serve, he says, to impart the active substance to bodies; "and where activity is without any *manifest* origin, the active substance is derived from an invisible source."

Our limits will not permit us to attend him in his solution of all the apparent activities in bodies; but the orbicular motions of the planets have been accounted for in so many different ways by philosophers ancient and modern, and each account has been so little satisfactory to him who can think, and wishes to trace effects from adequate causes, that we consider it as our duty to furnish our readers with the account of this phenomenon which is given by Mr Young.

18 and causes the motion of the heavenly bodies.

The question which has been so long agitated, "Whence is the origin of motion?" our author considers as implying an absurdity. "It supposes (says he) that rest was the primitive state of matter, and that motion was produced by a subsequent act. But this supposition must ever be rejected, as it is giving precedency to the inferior, and inverting the order of nature." The substance which he holds to be the basis of matter is essentially active; and its action is motion. This motion, however, in the original element, was *power* without direction, agency without order, activity to no end. To this power it was necessary that a LAW should be superadded; that its agency should be guided to some regular purpose, and its motion conspire to the production of some uniform effects. Our author shows, or endeavours to show, by a process of reasoning which shall be examined elsewhere, that the primary atoms of matter are produced by the circular motion of the parts of this substance round a centre; and that a similar motion of a number of these atoms around another centre common to them all, produces what in common language is called a *solid body*; a cannon ball, for instance, the terrestrial globe, and the body of the sun, &c. In a word, he labours to prove, and with no small success, that a principle of union is implied in the revolving or circulating movements of the active substance. Motion.

"But we may also assume (he says) *à priori*, that a principle of union is a general law of nature; because we see in fact all the component parts of the universe are united systems, which successively combine into larger unions, and ultimately form *one* whole." Let us then suppose the sun with all his planets, primary and secondary, to be already formed for the purpose of making one system, and the orbits of all of them, as well as these great bodies themselves, to be pervaded by the active substance, which necessarily exists in a state of motion, and is the cause of the motion of every thing corporeal. "If to this motion a principle of union be added, the effect of such a principle would be a determination of all the parts of the active substance, and of course all the bodies to which it is united, towards a common centre, which would be at rest, and void of any tendency in any direction. But this determination of all the parts of the system towards a common centre, tends to the destruction both of the motion of the active substance and of the system; for should all the parts continually approximate from a circumference towards a centre, the sun and planets would at last meet, and form one solid and quiescent mass. But to preserve existence, and consequently motion, is the first law of the active substance, as of all being; and it cannot be doubted, that to preserve distinct the several parts of the solar system, is the first law given to the substance actuating that system. The union of the system is a subsequent law.

"When the *direct* tendency of any inferior law is obviated by a higher law, the inferior law will operate *indirectly* in the manner the nearest to its direct tendency that the superior law will permit. If a body in motion be obliquely obstructed, it will move on in a direction oblique to its first motion. Now the law of union, which pervades the solar system, being continually obstructed by the law of self-preservation, the motion of the active substance, and of the bodies to which it is united, can be no other than a revolving motion *about* the common centre of approach, *towards* which all the parts have a determination. But when this revolution has actually taken place, it gives birth to a new tendency, which supersedes the operation of the law of self-preservation. It has been shown, that the motion essential to the active substance, required to be governed by some law to give being to an orderly state of things. Now, there are motions simple and motions complex; the more simple is in all things first in order, and out of the more simple the more complex arises in order posterior. The most simple motion is rectilineal; therefore a rectilineal motion is to be considered as that which is the original and natural state of things, and consequently that to which *all things tend*. It will follow from hence, that when any portion of active substance in which the *law of union* operates, has in the manner above explained been compelled to assume a revolving motion, that is, a motion in some curve; a tendency to a rectilineal motion will continually exist in every part of the revolving portion, and in every point of the curve which it describes during its revolution. And this rectilineal tendency will be a tendency to recede from the centre in every

Motion. point of the revolving orbit, and to proceed in a tangent to the orbit at each point. These two tendencies, if not originally equal, must necessarily in all cases arrive at an equality. For the tendency towards the centre, called the *centripetal* tendency, that is, the *law of union*, operating first, if we suppose the motion approaches the centre, the tendency to recede from it, called the *centrifugal* tendency, will have its proportion to the centripetal continually increased as the orbit of revolution grows less, so as ultimately to equal the centripetal tendency, and restrain the motion from its central course, at which point it will no longer seek the centre but revolve round it."

As our author holds that every atom of matter is formed by the motion of parts of the active substance, and every body formed by the motion of atoms; so he maintains, not only that the sun, moon, earth, planets, and stars, are penetrated by the same substance, but that each is the centre of a vortex of that substance, and that of these vortices some are included within others. "The subtle revolving fluid, the centre of whose vortex the earth occupies, not only surrounds but pervades the earth, and other vortices their earths, to their centres; and the earth and planets are by its revolutions carried around on their own axes. The earth is an active mass, and all its component masses are severally as well as collectively inactive; but the earth and all its parts have various collective and separate movements, imparted from the fluid which surrounds, pervades, and constitutes it. Being immersed together with its proper surrounding sphere or vortex in the larger sphere or vortex of the sun, it is carried thereby in a larger orbit about the sun, at the same time that by the revolution of its proper sphere it rotates on its own axis."

19 Objections to this theory.

Such is the most complete view which our limits will permit us to give of Mr Young's theory of motion. To the philosopher who considers experiment as the only test of truth, and who in all his inquiries employs his hands more than his head, we are fully aware that it will appear in no better light than as "the baseless fabric of a vision." Even to the intellectual philosopher who is not frightened at the word *metaphysics*, we are afraid that such an active substance as the author contends for, will appear as inadequate to the production of the phenomena of gravitation and repulsion as the material æther of Mr Jones and his followers. A being void of intelligence, whether it be material or immaterial, quiescent or motive, cannot be the subject of law, in the proper sense of the word. The laws of which Mr Young speaks as necessary to regulate the motions of the active substance, must be mere *forces*, applied by some extrinsic and superior power. And since "motion, as it is *essential* to the active substance, is power without direction, agency without order, activity to no end; since it is of such a nature, that from its unguided agitations there could result neither connection, order, nor harmony;" it follows that those extrinsic forces must be *perpetually* applied, because what is *essential* to any substance can never be destroyed or changed so long as the substance itself remains.

Forces producing order out of confusion, can be applied only by a being possessed of intelligence; and if the immediate and perpetual agency of an intelligent being be necessary to regulate the motions of the active substance, that substance itself may be thought superfluous, and its very existence be denied. *Entia non sunt multiplicanda absque necessitate*, is a rule of philosophizing which every man of science acknowledges to be just. And it will hardly be denied that the immediate and perpetual agency of an intelligent being upon Mr Jones's etherial fluid, or even upon the matter of solid bodies themselves, would be capable of producing every kind of motion without the instrumentality of a substance which is neither mind nor matter.

Such, we conceive, are the objections which our metaphysical readers may make to this theory. Part of their force, however, will perhaps be removed by the ingenious manner in which our author analyzes matter into an immaterial principle. But so much of it remains, that the writer of this article is inclined to believe that no mechanical account can be given of the motions of the heavenly bodies, the growth of plants, and various other phenomena which are usually solved by attraction and repulsion. In the present age, philosophers in general are strangely averse from admitting on any occasion the agency of mind; yet as every effect must have a cause, it is surely not irrational to attribute such effects as mechanism cannot produce to the operation either of intelligence or instinct. To suppose the Deity the immediate agent in the great motions of the universe, has been deemed impious; and it must be confessed that very impious conclusions have been deduced from that principle. But there is surely no impiety in supposing, with the excellent bishop of Cloyne, that the fluid which is known to pervade the solar system, and to operate with resistless force, may be animated by a powerful mind, which acts instinctively for ends of which itself knows nothing. For the existence of such a mind, no other evidence, indeed, can be brought than what is afforded by a very ancient and very general tradition, and by the impossibility of accounting for the phenomena upon principles of mere mechanism. Perhaps some of our more pious readers may be inclined to think that the Supreme Being has committed the immediate government of the various planetary systems to powerful *intelligences*, or ANGELS, who, as his ministers, direct their motions with wisdom and foresight. Such an opinion is certainly not absurd in itself; and it seems to be countenanced by an ancient writer *, who, though not known by the name of a philosopher, knew as much of the matter as any founder of the most celebrated school.

20 Other theories more ancient and rational.

* *Psal.* civ

To object to either of these hypotheses, as has been sometimes done, that it represents the government of the world as a perpetual miracle, betrays the grossest ignorance; for we might as well call the movements of the bodies of men and brutes, which are certainly produced by minds, miraculous. We do not affirm that either hypothesis is certainly true; but they are both as probable and as satisfactory as the hypothesis which attributes agency to attraction and repulsion, to a subtle æther, or to a substance which is neither mind nor matter. Were the immediate agency of intellect to be admitted, there would be no room for many of those disputes which have been agitated among philosophers, about the increase or diminution of motion

in

Motion

in the universe; because an intelligent agent, which could begin motion as well as carry it on, might increase or diminish it as he should judge proper. If instinctive agency, or something similar to it, be adopted, there is the same room for investigation as upon the principles of mechanism; because instinct works blindly, according to steady laws imposed by a superior mind, which may be discovered by observation of their effects. As we consider this as by much the most probable hypothesis of the two, we find ourselves involved in the following question: "If a certain quantity of motion was originally communicated to the matter of the universe, how comes it to pass that the original quantity still remains?" Considering the many opposite and contradictory motions which since the creation have taken place in the universe, and which have undoubtedly destroyed a great part of the original quantity, by what means has that quantity been restored?

21 The question, Whether the original quantity of motion in the world remains unimpaired? answered by

If this question can be solved by natural means, it must be upon the principles of Newton; for, "in every case* where quantities and relations of quantities are required, it is the province of mathematics to supply the information sought; "and all philosophers agree that Sir Isaac's doctrine of the composition and resolution of motion, though in what respects the heavenly bodies it may have no physical reality, is so mathematically just, as to be the only principle from which the quantity of motion, or the force of powers, can in any case be computed. If we choose to answer the question, by saying that the motion left is restored by the interposition of the Deity, then we might as well have had recourse to him at first, and say that he alone is the true principle of motion throughout the creation.

* *Young's Essay on the Powers and Mechanism, &c.*

22 The Cartesians, and

Before we are reduced to this dilemma, however, it is necessary, in the first place, to inquire whether there is or can be any real diminution of the quantity of motion throughout the universe? In this question the Cartesians take the negative side; and maintain, that the Creator at the beginning impressed a certain quantity of motion on bodies, and that under such laws as that no part of it should be lost, but the same portion of motion should be constantly preserved in matter: and hence they conclude, that if any moving body strike on any other body, the former loses no more of its motion than it communicates to the latter.

23 by Newton.

Sir Isaac Newton takes the contrary side, and argues in the following manner: "From the various compositions of two motions, it is manifest there is not always the same quantity of motion in the world; for if two balls, joined together by a slender wire, revolve with an uniform motion about their common centre of gravity, and at the same time that centre be carried uniformly in a right line drawn in the plane of their circular motion, the sum of the motions of the two balls, as often as they are in a right line, drawn from their common centre of gravity, will be greater than the sum of their motions when they are in a line perpendicular to that other. Whence it appears, that motion may be both generated and lost. But by reason of the tenacity of fluid bodies, and the friction of their parts, with the weakness of the elastic power in solid bodies, nature seems to incline much rather to the destruction than the production of motion; and in reality, motion becomes continually less and less.— For bodies which are either so perfectly hard or so soft as to have no elastic power, will not rebound from each other; their impenetrability will only stop their motion. And if two such bodies equal to one another be carried with equal but opposite motions, so as to meet in a void space, by the laws of motion they must stop in the very place of concourse, lose all their motion, and be at rest for ever, unless they have an elastic power to give them a new motion. If they have elasticity enough to make them rebound with one-fourth, one-half, or three-fourths, of the force they meet with, they will lose three-fourths, one-half, or one-fourth, of their motion. And this is confirmed by experiments: for if two equal pendulums be let fall from equal heights, so as to strike full upon each other; if those pendulums be of lead or soft clay, they will lose all, or almost all, their motion; and if they be of any elastic matter, they will only retain so much motion as they receive from their elastic power."

Motion

Motion, therefore, being thus, in the opinion of our celebrated author, *lost*, or *absolutely destroyed*, it is necessary to find some cause by which it may be renewed. Such renovation Sir Isaac attributes to *active* principles; for instance, "the cause of gravity, whereby the planets and comets preserve their motions in their orbits, and all bodies acquire a great degree of motion in falling; and the cause of fermentation, whereby the heart and blood of animals preserve a perpetual warmth and motion, the inner parts of the earth are kept perpetually warmed; many bodies burn and shine, and the sun himself burns and shines, and with his light warms and cheers all things."

Elasticity is another cause of the renovation of motion mentioned by Sir Isaac. "We find but little motion in the world (says he), except what plainly flows either from these active principles, or from the command of the willer."

24 No power of motion ever lost or destroyed.

With regard to the *destruction* or positive *loss* of motion, however, we must observe, that notwithstanding the authority of Sir Isaac Newton, it is altogether impossible that any such thing can happen. All moving bodies which come under the cognizance of our senses are merely passive, and acted upon by something which we call *powers* or *fluids*, and which are to us totally invisible. Motion, therefore, cannot be lost without a destruction or diminution of one of these *powers*, which we have no reason to think can ever happen. When two pendulums rush against each other, the motion is the mere effect of the action of gravity; and that action, which in this case is the *power*, continues to be the very same whether the pendulum moves or moves not. Could motion, therefore, be exhausted in this case, we must suppose, that by separating two pendulums to the same distance from each other, and then letting them come together for a great number of times, they would at last meet with less force than before. But there is certainly not the least foundation for this supposition; and no rational person will take it into his head, that supposing the whole human race had employed themselves in nothing else from the creation to the present day, but separating pendulums and letting them stop each other's motion, they would now come together with less force than they did at first. *Power*, therefore, which is the cause

Motion. of motion, is absolutely indestructible. Powers may indeed counteract one another, or they may be made to counteract themselves; but the moment that the obstacle is removed, they show themselves in their pristine vigour, without the least symptom of abatement or decay.

Whether, therefore, we reckon the ultimate source of motion to be spiritual or material, it is plain that it must be, to our conceptions *infinite;* neither will the phenomena of nature allow us to give any other explanation than we have done: for no power whatever can lose more than its own quantity; and it seems absurd to think that the Deity would create the world in such a manner that it would ultimately become immoveable, and then have recourse to unknown principles to remedy the supposed defect. On the principle we have now just laid down, however, the matter becomes exceedingly plain and obvious. The Creator at first formed two opposite powers, the action of which is varied according to the circumstances of the bodies upon which they act; and these circumstances are again varied by the action of the powers themselves in innumerable ways upon one another, and the approach of one body to another, or their receding to a greater distance. Where these powers happen to oppose each other directly, the body on which they act is at rest; when they act obliquely, it moves in the diagonal; or if the force acting upon one side is by any means lessened, the body certainly must move towards that side, as is evident from the case of the atmosphere, the pressure of which, when removed from one side of a body, will make it move very violently towards that side; and if we could continually keep off the pressure in this manner, the motion would assuredly be *perpetual.* We must not imagine that motion is *destroyed* because it is *counteracted;* for it is impossible to destroy motion by any means but removing the cause; counteracting the effect is only a temporary obstacle, and must cease whenever the obstacle is removed. Nature, therefore, having in itself an *infinite* quantity of motion, produces greater or lesser motions, according to the various action of the moving powers upon different bodies or upon one another, without a possibility of the general stock being either augmented or diminished, unless one of the moving powers was to be withdrawn by the Creator; in which case, the other would destroy the whole system in an instant. As to the nature of these great original powers, we must confess ourselves totally ignorant; nor do we perceive any data from which the nature of them can be investigated. The elements of light, air, &c. are the agents; but in what manner they act, or in what manner they received their action, can be known only to the Creator.

25 The nature of the moving powers unknown.

Perpetual MOTION, in *Mechanics*, a motion which is supplied and renewed from itself, without the intervention of any external cause; or it is an uninterrupted communication of the same degree of motion from one part of matter to another, in a circle or other curve returning into itself, so that the same momentum still returns undiminished upon the first mover.

The celebrated problem of a perpetual motion consists in the inventing a machine, which has the principle of its motion within itself. M. de la Hire has demonstrated the impossibility of any such machine, and finds that it amounts to this, viz. to find a body which is both heavier and lighter at the same time, or to find a body which is heavier than itself. Motion.

Animal MOTION, that which is performed by animals at the command of the mind or will.

Though all the motions of animals, whether voluntary or involuntary, are performed by means of the muscles and nerves, yet neither these nor the subtile fluid which resides in them are to be accounted the ultimate sources of animal motion. They depend entirely upon the mind for those motions which are properly to be accounted *animal.* All the involuntary motions, such as those of the blood, the heart, muscles, organs subservient to respiration and digestion, &c. are to be classed with those of vegetables; for though no vegetables have them in such perfection as animals, there are yet traces of them to be found evidently among vegetables, and that so remarkable, that some have imagined the animal and vegetable kingdoms to approach each other so nearly that they could scarce be distinguished by a philosophic eye. See MUSCLE.

Though the motions of animals, however, depend on the action of the mind or of the will, external objects seem originally to have the command of the mind itself; for unless an animal perceive something, it will not be inclined to act. By means of the ideas once received, indeed, and retained in the memory, it acquires a self-moving power, independent of any object present at the time, which is not the case with vegetables; for however they may act from a present impulse, their motions never appear to be derived from any source which may not be accounted strictly mechanical.

According to some, motion is the cause of sensation itself; and indeed it seems very probable that the motions of that subtle fluid, called *light* or *electricity*, in our bodies always accompany our sensations; but whether these be the *cause*, or only the *medium*, of sense, cannot be discovered.

Though all animals are endowed with a power of voluntary motion, yet there is a very great variety in the degrees of that power; to determine which no certain rules can assigned; neither can we, from the situation and manner of life of animals, derive any probable reason why the motion of one should differ so very much from that of another. This difference does not arise from their size, their ferocity, their timidity, nor any other property that we can imagine. The elephant, though the strongest land animal, is by no means the slowest in its motions; the horse is much swifter than the bull, though there is not much difference in their size; a greyhound is much swifter than a cat, though the former be much larger, and though both live in the same manner, viz. by hunting. Among insects the same unaccountable diversity is observable. The louse and flea are both vermine, are both nearly of the same size, and both feed on the bodies of animals; yet there is no comparison between the swiftness of their motions: while the bug, which is much larger than either, seems to have a kind of medium swiftness between both.—This very remarkable circumstance seems not even to depend on the range which animals are obliged to take in order to procure food for themselves: the motion of a snail is slower than that of an earth worm; while

that

Motion. that of many caterpillars is much quicker than either; though we can scarce determine which of the three has the greatest or the least extensive range for its food.

Of all animals the shell fish move the slowest, insomuch that some have supposed them to be entirely destitute of locomotive powers; and muscles particularly are denied to have any faculty of this kind. Every one knows that these animals can open and shut their shells at pleasure; and it cannot escape observation, that in every muscle there is a fleshy protuberance of a much redder colour than the rest. This has been thought to be a tongue or proboscis, by which the animal takes in its food; but is in reality the instrument of its motion from place to place. This protuberance is divided into two lobes, which perform the office of feet. When the river muscle is inclined to remove from its station, it opens its shells, thrusts out this protuberance, and digs a furrow in the sand; and into this furrow, by the action of the same protuberance, the shell is made to fall in a vertical position. It is recovered out of this into the former horizontal one, by pushing back the sand with the same tentacula, lengthening the furrow, and thus the animal continues its journey by a continual turning topsy-turvy.—Marine muscles perform their motions in the same manner, and by similar instruments. In general they are firmly attached to rocks or small stones by threads about two inches long, which are spun from a glutinous substance in the protuberances already mentioned.

Other animals which inhabit bivalved shells, perform their motions by a kind of leg or foot; which, however, they can alter into almost any figure they please. By means of this leg they can not only sink into the mud, or rise out of it at pleasure, but can even leap from the place where they are; and this can be done by the limpit, which people are apt to imagine one of the most sluggish animals in nature.—When this creature is about to make a spring, it sets its shell on edge, as if to diminish friction; then, stretching out the leg as far as possible, it makes it embrace a portion of the shell, and by a sudden movement, similar to that of a spring let loose, it strikes the earth with its leg, and actually leaps to a considerable distance.

The spout, or razor-fish, is said to be incapable of moving forward horizontally on the surface; but it digs a hole sometimes two feet deep in the sand, in which it can ascend or descend at pleasure. The leg, by which it performs all its movements, is fleshy, cylindrical, and pretty long; and the animal can at pleasure make it assume the form of a ball. When lying on the surface of the sand, and about to sink into it, the leg is extended from the inferior end of the shell, and makes the extremity of it take on the form of a shovel, sharp on each side, and terminating in a point. With this instrument the animal makes a hole in the sand; after which it advances the leg still farther into it, makes it assume the form of a hook, and with this, as a fulcrum, it obliges the shell to descend into the hole. This operation is continued until the whole shell be covered; and when the animal wishes to regain the surface, it makes the extremity of the leg to assume the form of a ball, and makes an effort to extend it. The ball, however, prevents any farther descent, and the reaction of the muscular effort raises up the whole shell, which operation is continued until it reaches the surface; and it is surprising with what facility these motions are accomplished by an animal seemingly so little qualified to move at all. Another particularity in this fish is, that though it lives among salt water, it abhors salt so much, that when a little is thrown into its hole it instantly leaves it. But it is still more remarkable, that if you once take hold of the spout-fish, and then allow it to retire into its hole, it cannot then be driven out by salt; though unless it be taken hold of by the hand, the application of salt will make it come to the surface as often as you please. Motion.

All other shell fish, even those apparently the most sluggish and destitute of any apparatus for motion, are found to be furnished with such instruments as enable them to perform all those movements for which they have any occasion. Thus the scallop, a well-known animal inhabiting a bivalved shell, can both swim upon the surface of water and move upon land. When it happens to be deserted by the tide, it opens its shell to the full extent, and shutting it again with a sudden jerk, the reaction of the ground gives such an impulse to the whole, that it sometimes springs five or six inches from the ground; and by a continued repetition of this action, it gradually tumbles forward until it regains the water. Its method of sailing is still more curious. Having attained the surface of the water by means unknown to us, it opens the shell, and puts one-half above water, the other with the body of the animal in it remaining below. Great numbers of them are thus frequently seen sailing in company with their shells sticking up above water when the weather is fine, and the wind acting upon them as sails; but on the least alarm they instantly shut their shells, and all sink to the bottom together.

The oyster has generally been supposed one of the most sluggish animals in nature, and totally incapable of voluntary motion; but from the researches of the Abbé Dicquemarre, this opinion seems to be erroneous. The oyster, like many other bivalved shell-fish, has a power of squirting water out from its body; and this property may easily be observed by putting some of them into a plate with as much sea water as will cover them. The water is ejected with so much force, as not only to repel the approach of ordinary enemies, but to move the whole animal backwards or sidewise, in a direction contrary to that in which the water was ejected. It has been also supposed, that oysters are destitute of sensation; but M. Dicquemarre has shown, that they not only possess sensation, but that they are capable of deriving knowledge from experience. When removed from such places as are entirely covered with the sea, when destitute of experience, they open their shells and die in a few days; but if they happen to escape this danger, and the water covers them again, they will not open their shells again, but keep them shut, as if warned by experience to avoid a danger similar to what they formerly underwent.

The motions of the sea-urchin are perhaps more curious and complicated than those of any other animal. It inhabits a beautiful multivalved shell, divided into triangular compartments, and covered with great numbers of prickles; from which last circumstance it receives the name of *sea urchin* or *sea hedgehog*. The triangles

Motion. triangles are separated from one another by regular belts, and perforated by a great number of holes, from every one of which issues a fleshy horn similar to that of a snail, and capable of moving in a similar manner. The principal use of these horns seems to be to fix the animal to rocks or stones, though it likewise makes use of them in its progressive motion. By means of these horns and prickles, it is enabled to walk either on its back or its belly; but it most commonly makes use of those which are near the mouth. Occasionally it has a progressive motion by turning round like a wheel.

The animals called *sea-nettles* or *medusæ*, though extremely slow in their motions, are nevertheless evidently capable of moving at pleasure from place to place. The variety of their figure is such, that it is difficult to assign them any determinate figure whatever. In general, however, they resemble a truncated cone, the base of which is applied to the rock to which they adhere. Their colours are various, whitish, brown, red or greenish: the mouth is very large; and when opened appears surrounded with filaments resembling the horns of snails, which being disposed in three rows around it, give the animal the appearance of a flower; and through every one of these the animal has the power of squirting the sea water. The structure of these animals is extremely singular; they consisting all of one organ, viz. a stomach. When searching for food, they extend their filaments, and quickly entangle any small animals that come within their reach. The prey is instantly swallowed, and the mouth shut close upon it like a purse; in which state it remains for many days before the nutritive parts are extracted. The animal, though scarcely an inch or an inch and a half in diameter, is nevertheless so dilatable, that it can swallow large whelks and muscles, the shells of which are thrown out by the mouth after the nutritive parts have been exhausted. Sometimes the shell is too large to be voided this way; in which case the body of the animal splits, and the shell is voided through the opening, which in a short time heals up again. The progressive motion of this creature is so slow, that it resembles that of the hour hand of a clock, and is performed by means of innumerable muscles placed on the outside of the body. All these are tubular, and filled with a fluid, which makes them project like prickles. On occasion it can likewise loosen the base of the cone from the rock, and inverting its body, move by means of the filaments already mentioned, which surround the mouth; but even the motion performed in this manner is almost as slow as the other.

Some animals are capable of moving backwards, apparently with the same facility that they do forwards, and that by means of the same instruments which move them forward. The common house fly exhibits an instance of this, and frequently employs this retrograde motion in its ordinary courses; though we cannot know the reason of its employing such an extraordinary method. Another remarkable instance is given by Mr Smellie in the *mason-bee*. This is one of the solitary species, and has its name from the mode of constructing its nest with mud or mortar. Externally this nest has no regular appearance, but at first sight is taken for a quantity of dirt adhering to the wall; though the internal part be furnished with cells in the same regular manner with the nests of other insects of the bee kind. When this bee leaves its nest, another frequently takes possession of it; in which case a battle never fails to ensue on the return of the real proprietor. The dispute is decided in the air; and each party endeavours to get above the other, as birds of prey are wont to do in order to give a downward blow. The undermost one, to avoid the stroke, instead of flying forward or laterally, always flies backward. The encounter is so violent, that when they strike, both parties fall to the ground. Motion.

Vegetable Motion. Though vegetables have not the power of moving from one place to another like animals, they are nevertheless capable of moving their different parts in such a manner as would lead us to suspect that they are actuated by a sort of instinct. Hence many have been induced to suppose, that the animal and vegetable kingdoms are in a manner indistinguishable from one another; and that the highest degree of vegetable life can hardly be known from the lowest degree of animal life. The essential and insuperable distinction however between the two, is the faculty of sensation, and loco-motion in consequence of it. Were it not, indeed, for the manifestation of sense by moving from one place to another, we should not be able to tell whether vegetables were possessed of sensation or not; but whatever motions they may be possessed of, it is certain that no vegetable has the faculty of moving from one place to another. Some have endeavoured to distinguish the two kingdoms by the digestion of food; alleging that plants have no proper organs, such as a stomach, &c. for taking in and digesting their aliment. But to this it has been replied, that the whole body of a vegetable is a stomach, and absorbs its food at every pore. This, however, seems not to be a sufficient answer. All animals take in their food at intervals, and there is not a single instance of one which eats perpetually. The food is also taken into the body of the animal, and application of the parts made by means of the *internal* organization of the viscus; but in vegetables, their whole bodies are immersed in their food, and absorb it by the surface, as animal bodies will sometimes absorb liquids when put into them. The roots of a tree indeed will change their direction when they meet with a stone, and will turn from barren into fertile ground; but this is evidently mere mechanism, without any proof of will or sensation; for the nourishment of the root comes not from the stone, but from the earth around it; and the increase in size is not owing to any expansion of the matter which the root already contains, but to the apposition of new matter; whence the increase of size must always take place in the direction from whence the nourishment proceeds. On this principle also we may explain the reason why the roots of a tree, after having arrived at the edge of a ditch, instead of shooting out into the air, will creep down the one side, along the bottom, and up the other.

In their other movements the vegetables discover nothing like sensation or design. They will indeed uniformly bend towards light, or towards water; but in the one case we must attribute the phenomenon to the action of the elements of light and air upon them; and in the latter, the property seems to be the same; with what in other cases we call attraction. Thus, if

Motion. a root be uncovered, and a wet sponge placed near it in a direction different from that in which the root was proceeding, it will soon alter its position, and turn towards the sponge; and thus we may vary the direction of the root as often as we please. The efforts of a plant to turn from darkness or shade into sunshine are very remarkable; as in order to accomplish this, not only the leaves will be inclined, but even the stems and branches twisted. When a wet sponge is held under the leaves of a tree, they bend down in order to touch it. If a vessel of water be put within six inches of a growing cucumber, in less than 24 hours the latter will alter its direction; the branches will bend towards the water, and never alter their course until they come in contact with it. The most remarkable instance of this kind of motion, however, is, that when a pole is brought near a vine, the latter will turn towards it, and never cease extending its branches till it lays hold of the support.

The motions of the sensitive plant, and others of the same kind, have been considered as very wonderful; but it is doubtful if any of them be really more so than that of the vine just mentioned. None of these show any kind of propensity to move without an actual touch. A very slight one, indeed, makes the sensitive plant contract, and the whole branch, together with the leaves, bend down towards the earth.—These phenomena are by some ascribed to electricity. Even the motions of the *hedysarum gyrans*, which at first sight seem so much more surprising than those of the sensitive plant, may, it is supposed, admit of explanation upon the same principle. The American plant called *dionæa muscipula*, or *Venus's fly-trap*, is another example of very wonderful mechanism in vegetables, though even this does not argue any degree of sensation in this plant more than in others. The leaves of the dionæa are jointed, and furnished with two rows of prickles. A number of small glands upon the surface secrete a sweet juice which entices flies to come and settle upon it; but the moment these insects touch the fatal spot, the leaves fold up, and squeeze them to death between the prickles. The leaves fold up in the same manner when the plant is touched with a straw or pin. The *drosera rotundifolia* and *longifolia*, round and long-leafed sundew, plants of our own country, not uncommon in boggy ground, possess a similar structure, and perform similar functions.

The folding up of the leaves of certain plants in the absence of the sun's light, called their *sleep*, affords another very curious instance of vegetable motion.—Almost all vegetables, indeed, undergo such a remarkable change in the night, that it is difficult to know exactly how many kinds do really sleep. They fold up their leaves in many different ways; but all agree in disposing of them in such a manner as to afford the best protection to the young stems, flower buds or fruit. The leaves of the tamarind tree contract round the young fruit in order to protect it from nocturnal cold; and those of senna, glycina, and many other papilionaceous plants, dispose of their leaves in the same manner. The leaves of the chickweed, asclepias atriplex, &c. are disposed in opposite pairs. In the night time they rise perpendicularly, and join so close at the top that the flowers are concealed by them. In like manner do the leaves protect the flowers of the fida or althæa theophrasti, œnothera, solanum, and the Egyptian vetch. All these are erected during the night; but those of the white lupine, in time of sleep, hang down. Motion.

The flowers of plants also have motions peculiar to themselves. Many of them during the night are enclosed in their calyxes. Some, particularly those of the German spurge, geranium striatum, and common whitlow grass, when asleep, bend towards the earth; by which means the noxious effects of rain or dew are prevented. All these motions have been commonly ascribed to the sun's rays; and Mr Smellie informs us that in some of the examples above mentioned the effects were evidently to be ascribed to heat: but plants kept in a hot-house, where the temperature of the day and night are alike, contract their leaves, and sleep in the same manner as if they were exposed to the open air; "whence it appears (says he), that the sleep of plants, is owing rather to a peculiar law, than to a quicker or slower motion of the juices." He suspects, therefore, that as the sleep of plants is not owing to the mere absence of heat, it may be occasioned by the want of light; and to ascertain this he proposes an experiment of throwing upon them a strong artificial light. "If notwithstanding this light (says he), the plants are not roused, but continue to sleep as usual, then it may be presumed that their organs, like those of animals, are not only irritable, but require the reparation of some invigorating influence which they have lost while awake, by the agitations of the air and of the sun's rays, by the act of growing, or by some other latent cause." On this, however, we must remark, that the throwing of artificial light upon plants cannot be attended with the same consequences as that of the light of the sun, unless the former were as strong as the latter, which is impossible; and even granting that we could procure an artificial light as strong as that of the sun, a difference might be occasioned by the different directions of the rays, those of the sun being very nearly parallel, while the rays of all artificial light diverge very greatly. If, therefore, we are to make an experiment of this kind, the rays should be rendered parallel by means of a burning mirror. Here again we would be involved in a difficulty; for the rays of the sun proceed all in one direction, but as of necessity we must employ different mirrors in our experiment, the light must fall upon the plant in different directions, so that we could not reasonably expect the same result as when the plants are directly exposed to the rays of the sun.

The motion of plants, not being deducible from sensation, as in animals, must be ascribed to that property called *irritability*; and this property is possessed *insensibly* by the parts of animals in a greater degree than even by the most irritable vegetable. The muscular fibres will contract on the application of any stimulating substance, even after they are detached from the body to which they belonged. The heart of a frog will continue to beat when pricked with a pin for several hours after it is taken out of the body. The heart of a viper, or of a turtle, beats distinctly from 20 to 30 hours after the death of these animals. When the intestines of a dog, or any other quadruped, are suddenly cut into different portions, all of them crawl about like worms, and contract upon the slightest touch. The heart, intestines, and diaphragm, are the most irritable

Motion. irritable parts of animal bodies; and to discover whether this quality resides in all plants, experiments should be made chiefly on leaves, flowers, buds, and the tender fibres of the roots.

The motions of plants are universally ascribed by our author to *irritability*, to which also we have ascribed them under the article ANIMAL. The term, however, requires an explanation; and to give this in an intelligible manner requires some attention. The most obvious comparison is that of an electrified thread; which on the approach of any unelectrified substance, shows a variety of motions, equally surprising with those of the parts of plants or the muscular fibres cut out of the body. Could we suppose that the electricity of a thread might be preserved after it was cut off from the electrifying substance, it would show as much irritability as even the muscular fibres, or portions of the intestines of animals. We know, from the history of the torpedo, electrical eel, &c. that there are animals in which the electric fluid acts in such a manner as to produce a much more powerful effect than that of giving motion to the leaves of plants. The readiness, therefore, with which this fluid is thrown into agitations when any substance in which it acts is touched, is without doubt the irritability in question; but we have from thence no more reason to ascribe sensation to these irritable bodies, than to an electrified bottle when it discharges itself, or makes a cork ball play round it.

In a paper read before the Academy of Sciences at Paris, by M. Broussonet, the author inclines to confound irritability and sensibility together. The different parts of plants (says he) enjoy the faculty of motion; but the motions of a vegetable are very different in their nature from those of an animal: the most sensible, those that are produced with most rapidity in plants, are always influenced by some stimulating cause. Irritability, which is nothing but *sensibility* made manifest by motion, is a general law to which nature has subjected all living beings; and it is this that continually watches over their preservation. Being more powerful in animals than in plants, it may be often confounded in these last with phenomena that depend on a quite different cause. In the vegetable it is only the organ which is exposed to the action of the stimulating power that moves. Irritation in particular places never produces that prompt combination of sensations which we observe in animals; in consequence of which certain parts are put in motion without being directly affected, and which otherwise might have been passive.

"The more perfect the organization in the different parts of animals is, the more apparent are the signs of irritability. The parts that come nearest to those of vegetables, and in which of consequence the organization is most imperfect, are the least irritable. The same law holds with regard to plants; but the result is opposite: the signs of irritability are most sensible in proportion to the analogy of the parts with those of animals; and they are imperceptible in those that are dissimilar. This assertion is proved by what we observe in the organs destined in vegetables to perpetuate the species. Those parts alone seem sensible to stimuli; the bark, leaves, stalks, and roots showing no signs of irritability.

"The motions essentially vital, which have in plants the greatest affinity with those of animals, are the course of the sap, the passage of the air in the trachea, the different positions which the flowers of certain plants take at certain hours of the day, &c. But if we attend to the manner in which all these motions in plants are performed, we shall find that they present a greater number of modifications than the analogous motions that take place in animals. The temperature of the atmosphere, its agitation, light, &c. have great influence on the motions of plants, by accelerating or retarding the course of their fluids; and, as they cannot change their place, these variations produce in them changes more obvious and more uniform than in animals." Motion.

Our author now proceeds to inform us, that some of the motions of plants are occasioned by the rarity of the juices in plants, and others by their abundance. Of the former kind are those by which the capsules of some plants suddenly burst with a spring, and throw their seeds to some distance. Of the other kind are the action of the stamina in the *parietaria*, the inflection of the peduncles of flowers, and of the pistilla. "Those motions (says he) which are particularly observed in the organs destined to the reproduction of the individual, not appearing except in circumstances that render them absolutely necessary, seem in some measure to be the effect of a particular combination: they are, however, merely mechanical; for they are always produced in the same way and in the same circumstances. Thus the rose of Jericho, and the dry fruit of several species of *mesembryanthemum*, do not open but when their vessels are full of water.

"The sudden disengagement of fluids produces a kind of motion. To this cause we must attribute a great number of phenomena observable in the leaves of several plants, and which do not depend on irritability. The small glands in each leaf of the *dionæa* are no sooner punctured by an insect, that it instantly folds up and seizes the animal: the puncture seems to operate a disengagement of the fluid which kept the leaf expanded by filling its vessels. This explanation is the more probable, that in the early state of the vegetation of this plant, when the small glands are hardly evolved, and when probably the juices do not run in sufficient abundance, the leaves are folded up exactly as they appear when punctured by an insect at a more advanced period. We observe a phenomenon similar to this in both species of the *drosera* (sun-dew), mentioned above. The mechanism here is very easily observable: the leaves are at first folded up; the juices are not yet propelled into the fine hairs with which they are covered; but after they are expanded, the presence of the fluid is manifest by a drop seen at the extremity of each hair: it is by absorbing this fluid that an insect empties the vessels of the leaf, which then folds up, and resumes its first state: the promptitude of the action is proportioned to the number of hairs touched by the insect. This motion in some degree resembles that which takes place in the limb of an animal kept in a state of flexion by a tumor in the joint; when the matter which obstructed the motion is discharged, the limb instantly resumes its former position. The phenomena that depend on the abundance of fluids are particularly evident in plants which grow in wet soils; the *drosera* and *dionæa* are of this kind: and it is known

Motion || Motoualis.

by the experiments of Mess. Du Fay and Du Hamel, that sensitive plants are particularly sensible when the sun is obscured by clouds and the air warm and moist. The influence of external causes sometimes so modifies the vital motions in plants, that we would be tempted to ascribe them to volition, like those that depend entirely on that faculty in animals. If we set a pole in the ground near a twining plant, it always lays hold of the pole for support, in whatever place we put it. The same thing occurs in the tendrils of the vine; which always attach themselves to the support presented them, on whatever side it may be placed, provided they can reach it: but these motions are entirely vital: the twining plants and the tendrils direct themselves to every quarter, and consequently cannot fail of meeting with the bodies within their reach. These motions are performed as long as the parts continue to grow; but when they cease to elongate, if they have not been able to reach any body on which they can fix, they bend back upon themselves. This and other observations show how far the vital motions in plants may be modified by external causes, and how essentially they differ from those that are the effect of volition in animals.

"Some plants appear endowed with no sort of motion: some have leaves that can move in different directions: their motions are generally modified by different causes; but none appear so eminently possessed of this quality as the *hedysarum gyrans* of Linnæus.—No part of this plant shows any signs of irritability upon application of stimuli: and the motion of its foliola ceases when the leafets are agitated by the wind.—When the sun is warm, the little leaves of the hedysarum are also immoveable; but when the weather is warm and moist, or when it rains, they move very freely. This motion seems indispensably necessary to the plant; for it begins as soon as the first leaves unfold, and continues even during the night; but in time it grows weaker. In our stoves it is most considerable during the first year; in the second, it is not very sensible: in its native place all the leaves have a motion never observed here. The moving leafets are most agitated while the plants are in full flower, and the process of fructification goes on. The oscillatory motion is so natural to it, that it not only remains for three or four days in the leafets of a branch that has been cut off and put in water, but is even continued though the branch be exposed to the air. The leaves seem to perform the office of the heart in vegetables. When a plant is stripped of its leaves, the progress of vegetation is arrested; and such vegetables resemble those animals which have a periodical sleep, induced by a diminution of the action of the heart. Many plants hardly show any signs of motion; many seem also wholly cataleptic; which is rarely if ever found in animals. The footstalks of the flowers of dracocephalum, a Virginian plant, preserve themselves in whatever position they are placed.

Muscular Motion. See Muscle.

MOTIVE, is sometimes applied to that faculty of the human mind, by which we pursue good and avoid evil. Thus Hobbes distinguishes the faculties of the mind into two sorts, the cognitive and motive.

MOTOUALIS, a small nation of Syria, inhabiting to the east of the country of the Druses, in the valley which separates their mountains from those of Damascus; of which the following account is given by Volney in his Travels, vol. ii. Motoualis.

The characteristic distinction between them and the other inhabitants of Syria (says our author) is, that they, like the Persians, are of the sect of Ali, while all the Turks follow that of Omar or Moaouia. This distinction, occasioned by the schism which in the 36th year of the Hegira arose among the Arabs, respecting the successors of Mahomet, is the cause of an irreconcilable hatred between the two parties. The sectaries of Omar, who consider themselves as the only orthodox, assume the title of *Sonnites*, which has that signification, and term their adversaries *Shiites*, that is "sectaries of Ali." The word *Motouali* has the same meaning in the dialect of Syria. The followers of Ali, dissatisfied with this name, substitute that of *Adlia*, which means "assertors of justice," literally "Justiciarians:" a denomination which they have assumed in consequence of a doctrinal point they advance in opposition to the Sonnite faith. A small Arabic treatise, entitled Theological Fragments concerning the Sects and Religions of the World, has the following passage:

"These sectaries who pretend that God acts only on principles of justice, conformable to human reason, are called *Adlia* or *Justiciarians*. God cannot (say they) command an impracticable worship, nor ordain impossible actions, nor enjoin men to perform what is beyond their ability; but wherever he requires obedience, will bestow the power to obey. He removes the cause of evil, he allows us to reason, and imposes only what is easy, not what is difficult; he makes no man responsible for the actions of another, nor punishes him for that in which he has no part; he imputes not as a crime what himself has created in man; nor does he require him to avoid what destiny has decreed.—This would be injustice and tyranny, of which God is incapable, from the perfection of his being." To this doctrine, which diametrically opposes the system of the Sonnites, the Motoualis add certain ceremonies which increase their mutual aversion. They curse Omar and Moaouia as rebels and usurpers; and celebrate Ali and Hosain as saints and martyrs. They begin their ablutions at the elbow, instead of the end of the finger, as is customary with the Turks; they think themselves defiled by the touch of strangers; and, contrary to the general practice of the East, neither eat nor drink out of a vessel which has been used by a person not of their sect, nor will they even sit with such at the same table.

These doctrines and customs, by separating the Motoualis from their neighbours, have rendered them a distinct society. It is said they have long existed as a nation in this country, though their name has never been mentioned by any European writer before the 18th century; it is not even to be found in the maps of D'Anville: La Roque, who left their country not a hundred years ago, gives them the name of *Amediens*. Be this as it may, in the later times their wars, robberies, successes, and various changes of fortune, have rendered them of consequence in Syria. Till about the middle of this century, they only possessed Balbec their capital, and a few places in the valley, and Anti-Lebanon, which seems to have been their original

Motoualis. Motto.

country. At that period we find them under a like government with the Druzes, that is to say, under a number of Shaiks, with one principal chief of the family of Harfoush. After the year 1750 they established themselves among the heights of Bekaa, and got footing in Lebanon, where they obtained lands belonging to the Maronites, almost as far as Besharrai. They even incommoded them so much by their ravages, as to oblige the emir Yousef to attack them with open force and expel them; but on the other side, they advanced along the river even to the neighbourhood of Sour (Tyre). In this situation, Shaik Daher had the address, in 1760, to attach them to his party.—The pachas of Saide and Damascus claimed tributes, which they had neglected paying, and complained of several robberies committed on their subjects by the Motoualis; they were desirous of chastising them; but this vengeance was neither certain nor easy. Daher interposed; and by becoming security for the tribute, and promising to prevent any depredations, acquired allies who were able, as it is said, to arm 10,000 horsemen, all resolute and formidable troops. Shortly after they took possession of Sour, and made this village their principal sea port. In 1771 they were of great service to Ali Bey and Daher against the Ottomans. But Emir Yousef having in their absence armed the Druzes, ravaged their country. He was besieging the castle of Djezin, when the Motoualis, returning from Damascus, received intelligence of this invasion. At the relation of the barbarities committed by the Druzes, an advanced corps, of only 500 men, were so enraged, that they immediately rushed forward against the enemy, determined to perish in taking vengeance. But the surprise and confusion they occasioned, and the discord which reigned between the two factions of Mansour and Yousef, so much favoured this desperate attack, that the whole army, consisting of 25,000 men, was completely overthrown.

In the following year, the affairs of Daher taking a favourable turn, the zeal of the Motoualis cooled towards him, and they finally abandoned him in the catastrophe in which he lost his life. But they have suffered for their imprudence under the administration of the pacha who succeeded him. Since the year 1777, Djezzar, master of Acre and Saide, has incessantly laboured to destroy them. His persecution forced them in 1784 to a reconciliation with the Druzes, and to enter into an alliance with the emir Yousef. Though reduced to less than 700 armed men, they did more in that campaign than 15,000 or 20,000 Druzes and Maronites assembled at Dair-el Kamar. They alone took the strong fortress of Mar-Djebaa, and put to the sword 50 or 60 Epirots who defended it. But the misunderstanding which prevailed among the chiefs of the Druzes having rendered abortive all their operations, the pacha has obtained possession of the whole valley, and the city of Balbec itself. At this period not more than 500 families of the Motoualis remained, who took refuge in Anti-Lebanon, and the Lebanon of the Maronites; and, driven as they now are from their native soil, it is probable they will be totally annihilated, and even their very name become extinct.

MOTTO, in armoury, a short sentence or phrase, carried in a scroll, generally under, but sometimes over the arms: sometimes alluding to the bearing, sometimes to the name of the bearer, and sometimes containing whatever pleases the fancy of the deviser.

Motto ‖ Moufet.

MOVEABLE, in general, denotes any thing capable of being moved.

Moveable Feasts, are such as are not always held on the same day of the year or month; though they be on the same day of the week. See Feasts.

Thus, Easter is a moveable feast, being always held on the Sunday which falls upon or next after the first full moon following the 21st of March.

All the other moveable feasts follow Easter, i. e. they keep their distance from it; so that they are fixed with respect thereto.

Such are Septuagesima, Sexagesima, Ash Wednesday, Ascension day, Pentecost, Trinity Sunday, &c. which see under their proper articles, Septuagesima, &c.

Moveable Subject, in *Law*, any thing that moves itself, or can be moved; in contradistinction to immoveable or heritable subjects, as lands, houses, &c.

MOVEMENT, Motion, a term frequently used in the same sense with automaton.

The most usual movements for keeping time are watches and clocks: the first are such as show the parts of time, and are portable in the pocket; the second, such as publish it by sounds, and are fixed as furniture. See Horology.

Movement, in its popular use among us, signifies all the inner works of a watch, clock, or other engine, which move, and by that motion carry on the design of the instrument.

The movement of a clock or watch is the inside, or that part which measures the time, strikes, &c. exclusive of the frame, case, dial plate, &c.

The parts common to both of these movements are, the main-spring, with its appurtenances; lying in the spring box, and in the middle thereof lapping about the spring-arbor, to which one end of it is fastened. A-top of the spring-arbor is the endless screw and its wheel; but in spring-clocks, this is a ratchet-wheel with its click, that stops it. That which the main-spring draws, and round which the chain or string is wrapped, is called the *fusy;* this is ordinarily taper; in large works, going with weights, it is cylindrical, and called the *barrel.* The small teeth at the bottom of the fusy or barrel, which stop it in winding up, is called the *ratchet;* and that which stops it when wound up, and is for that end driven up by the spring, the *garde-gut.* The wheels are various: the parts of a wheel are, the hoop or rim, the teeth, the cross and the collet or piece of brass soldered on the arbor or spindle whereon the wheel is rivetted. The little wheels playing in the teeth of the larger are called *pinions;* and their teeth, which are 4, 5, 6, 8, &c. are called *leves;* the ends of the spindle are called *pivots;* and the guttered wheel, with iron spikes at bottom, wherein the line of ordinary clocks runs, the *pulley.* We need not say any thing of the hand, screws, wedges, stops, &c. See Wheel, Fusy, &c.

Perpetual Movement. See *Perpetual Motion.*

MOUFET, Thomas, a celebrated English physician, was born at London, and practised medicine with great reputation. Towards the latter end of his life

Moufet || Moulds.

life he retired to the country, and died about the year 1600. This physician is known by a work which was begun by Edward Wotton, and printed at London in 1634, folio, with the title of *Theatrum Insectorum*. A translation of it into English was published at London in 1658 folio. Martin Lister gives a very unfavourable opinion of this book: "As Moufet (says he) made use of Wotton, Gesner, &c. an excellent work might have been expected from him; and yet his *Theatrum* is full of confusion, and he has made a very bad use of the materials with which these authors have furnished him. He is ignorant of the subject of which he treats, and his manner of expression is altogether barbarous. Besides this, he is extremely arrogant, to say no worse; for though he has copied Aldrovandus in innumerable places, he never once mentions his name." But Lay thinks that Lister, by expressing himself in this manner, has not done justice to Moufet; and he maintains that the latter has rendered an essential service to the republic of letters.

MOUG-DEN, or CHEN-YANG; a city of Chinese Tartary, and capital of the country of the Mantchews or Eastern Tartars. These people have been at great pains to ornament it with several public edifices, and to provide it with magazines of arms and storehouses. They consider it as the principal place of their nation; and since China has been under their dominion, they have established the same tribunals here as at Peking, excepting that called *Lii-pou*: these tribunals are composed of Tartars only; their determination is final; and in all their acts they use the Tartar characters and language. The city is built on an eminence; a number of rivers add much to the fertility of the surrounding country. It may be considered as a double city, of which one is enclosed within the other: the interior contains the emperor's palace, hotels of the principal mandarins, sovereign courts, and the different tribunals; the exterior is inhabited by the common people, tradesmen, and all those who by their employments or professions are not obliged to lodge in the interior. The latter is almost a league in circumference; and the walls which enclose both are more than three leagues round: these walls were entirely rebuilt in 1631, and repaired several times under the reign of Kang-hi.

MOULD, or MOLD, in the mechanic arts, &c. a cavity artificially cut, with a design to give its form or impression to some softer matter applied therein. Moulds are implements of great use in sculpture, foundery, &c. The workmen employed in melting the mineral or metallic ore dug out of mines, have their several moulds to receive the melted metal as it comes out of the furnace; but these are different according to the diversity of metals and works. In gold mines, they have moulds for ingots; in silver mines, for bars; in copper and lead mines, for pigs or salmons; in tin mines, for pigs and ingots; and in iron mines, for sows, chimney backs, anvils, caldrons, pots, and other large utensils and merchandises of iron; which are here cast, as it were, at first hand.

MOULDS of founders of large works, as statues, bells, guns, and other brazen works, are of wax, supported within-side by what we call a core, and covered without-side with a cape or case. It is in the space which the wax took up, which is afterwards melted away to leave it free, that the liquid metal runs, and the work is formed; being carried thither through a great number of little canals, which cover the whole mould. See FOUNDERY. Moulds.

MOULDS of moneyers are frames full of sand, wherein the plates of metal are cast that are to serve for the striking of species of gold and silver. See COINING.

A sort of concave moulds made of clay, having within them the figures and inscriptions of ancient Roman coins, are found in many parts of England, and supposed to have been used for the casting of money. Mr Baker having been favoured with a sight of some of these moulds found in Shropshire, bearing the same types and inscriptions with some of the Roman coins, gave an account of them to the Royal Society. They were found in digging of sand, at a place called Ryton in Shropshire, about a mile from the great Watling-street road. They are all of the size of the Roman denarius, and of little more than the thickness of our halfpenny. They are made of a smooth pot or brick clay, which seems to have been first well cleansed from dirt and sand, and well beaten or kneaded, to render it fit for taking a fair impression. There were a great many of them found together, and there are of them not unfrequently found in Yorkshire; but they do not seem to have been met with in any other kingdom, except that some have been said to be once found at Lyons. They have been sometimes found in great numbers joined together side by side, on one flat piece of clay, as if intended for the casting of a great number of coins at once; and both these, and all the others that have been found, seem to have been of the emperor Severus. They are sometimes found impressed on both sides, and some have the head of Severus on one side and some well known reverse of his on the other. They seem plainly to have been intended for the coinage of money, though it is not easy to say in what manner they can have been employed for that purpose, especially those which have impressions on both sides, unless it may be supposed that they coined two pieces at the same time by the help of three moulds, of which this was to be the middle one. If by disposing these into some sort of iron frame or case, as our letter-founders do the brass moulds for casting their types, the melted metal could be easily poured into them, it would certainly be a very easy method of coining, as such moulds require little time or expence to make, and therefore might be supplied with new ones as often as they happen to break.

These moulds seem to have been burnt or baked sufficiently to make them hard; but not so as to render them porous like our bricks, whereby they would have lost their smooth and even surface, which in these is plainly so close, that whatever metal should be formed in them would have no appearance like the sand-holes by which counterfeit coins and metals are usually detected.

MOULDS of founders of small works are like the frames of coiners: it is in these frames, which are likewise filled with sand, that their several works are fashioned; into which, when the two frames of which the mould is composed, are rejoined, the melted brass is run.

MOULDS of letter-founders are partly of steel and partly of wood. The wood, properly speaking, serves only to cover the real mould which is within, and to

Moulds. prevent the workman, who holds it in his hand, from being incommoded by the heat of the melted metal. Only one letter or type can be formed at once in each mould. See LETTER FOUNDERY.

MOULDS, in the manufacture of paper, are little frames composed of several brass or iron wires, fastened together by another wire still finer. Each mould is of the bigness of the sheet of paper to be made, and has a rim or ledge of wood to which the wires are fastened. These moulds are more usually called frames or forms. See *PAPER-Making*.

MOULDS, with furnace and crucible makers, are made of wood, of the same form with the crucibles; that is, in form of a truncated cone: they have handles of wood to hold and turn them with, when being covered with the earth, the workman has a mind to round or flatten his vessel.

MOULDS for leaden bullets are little iron pincers, each of whose branches terminates in a hemispherical concave, which when shut from an entire sphere. In the lips or sides where the branches meet is a little jet or hole, through which the melted lead is conveyed.

Laboratory MOULDS, are made of wood, for filling and driving all sorts of rockets and cartridges, &c.

Glaziers Moulds. The glaziers have two kinds of moulds, both serving to cast their lead: in the one they cast the lead into long rods or canes fit to be drawn through the vice, and the grooves formed therein; this they sometimes call ingot-mould. In the other, they mould those little pieces of lead a line thick and two lines broad, fastened to the iron bars. These may be also cast in the vice.

Goldsmiths Moulds. The goldsmiths use the bones of the cuttle fish to make moulds for their small works; which they do by pressing the pattern between two bones, and leaving a jet or hole to convey the metal through, after the pattern has been taken out.

MOULD, among masons, is a piece of hard wood or iron hollowed within side, answerable to the contours of the mouldings or cornices, &c. to be formed. This is otherwise *caliber*.

MOULDS, among plumbers, are the tables on which they cast sheets of lead. These they sometimes call simply *tables*. Besides which they have other real moulds, wherewith they cast pipes without soldering. See each described under PLUMBERY.

MOULDS, among the glass grinders, are wooden frames, whereon they make the tubes wherewith they fit their perspectives, telescopes, and other optic machines. These moulds are cylinders, of a length and diameter according to the use they are to be applied to, but always thicker at one end than the other, to facilitate the sliding. The tubes made on these moulds are of two kinds; the one simply of pasteboard and paper; the other of thin leaves of wood joined to the pasteboard. To make these tubes to draw out, only the last or innermost is formed on the mould; each tube made afterwards serving as a mould to that which is to go over it, but without taking out the mould from the first. See GRINDING.

MOULDS used in basket-making are very simple, consisting ordinarily of a willow or osier turned or bent into an oval, circle, square, or other figure, according to the baskets, panniers, hampers, and other utensils intended. On these moulds they make, or more properly measure all their work; and accordingly they have them of all sizes, shapes, &c.

Moulds || Moulinet.

MOULD, in ship-building, a thin flexible piece of timber, used by shipwrights as a pattern whereby to form the different curves of the timbers, and other compassing pieces in a ship's frame. There are two sorts of these, viz. the bend mould and hollow mould; the former of these determines the convexity of the timbers, and the latter their concavity on the outside, where they approach the heel, particularly towards the extremities of the vessel. The figure given to the timbers by this pattern is called their *bevelling*.

MOULDS, among tallow chandlers, are of two kinds: the first for the common dipped candles, being the vessel wherein the melted tallow is disposed, and the wick dipped. This is of wood, of a triangular form, and supported on one of its angles: so that it has an opening of near a foot a-top: the other, used in the fabric of mould candles, is of brass, pewter, or tin.—Here each candle has its several mould. See CANDLE.

MOULD, among gold-beaters, a certain number of leaves of vellum or pieces of gut, cut square of a certain size, and laid over one another, between which they put the leaves of gold and silver which they beat on the marble with the hammer. See GOLD LEAF.

They have four kinds of moulds; two whereof are of vellum and two of gut; the smallest of those of vellum consists of 40 or 50 leaves; the largest contains 100: for the others, each contains 500 leaves. The moulds have all their several cases, consisting of two pieces of parchment, serving to keep the leaves of the mould in their place, and prevent their being disordered in beating.

MOULD, in *Agriculture*, a general name for the soft earthy substance with which the dry land is generally covered, and in which all kinds of vegetables take root and grow. It is far from being an homogeneous substance; being composed of decayed animal and vegetable matters, along with calcareous, argillaceous, and siliceous earths, mixed together in various proportions, and with the different degrees of moisture, constituting every variety of SOIL.

MOULDINESS, is a white down or lanugo, which is produced on the surface of animal or vegetable matters in a state of putrefaction; and which viewed through a microscope appears like a kind of meadow, out of which arise herbs and flowers. See MUCOR, BOTANY *Index*.

MOULDING, any thing cast in a mould, or that seems to have been so, though in reality it were cut with a chisel or the axe.

MOULDINGS, in *Architecture*, projectures beyond the naked wall, column, wainscot, &c. the assemblage of which forms cornices, door cases, and other decorations of ARCHITECTURE. See that article.

MOULINET is used in *Mechanics*, to signify a roller, which being crossed with two levers, is usually applied to cranes, capstans, and other sorts of engines of the like nature to draw ropes, heave up stones, &c.

MOULINET is also a kind of turnstile or wooden cross, which turns horizontally upon a stake fixed in the ground; usually placed in passages to keep out horses, and to oblige passengers to go and come one by one. These moulinets are often set near the outworks

of

Moulinet || Mountain.

of fortified places at the sides of the barriers, through which people pass on foot.

MOULINS, a town of France, in the department of Allier, and containing about 13,200 inhabitants in 1800. The houses of the Chartreux, and that of the Visitation, are magnificent. It has a considerable trade in cutlery ware, and is seated on the river Allier, in a pleasant fertile plain, almost in the middle of France, 30 miles south of Nevers, and 55 north of Clermont. E. Long. 3. 25. N. Lat. 46. 34.

MOULTON, NORTH, a town of Devonshire, on the river Moul.

MOULTON, *South*, on the same stream, 182 miles from London. This, as well as the former, was anciently royal demesne. It sent members to parliament in the reign of Edward I. consists of a mayor, 18 capital burgesses, a recorder, town clerk, and 2 serjeants at mace. Its chief manufactures are serges, shalloons, and felts; and a considerable market for wool.

MOULTING, or MOLTING, the falling off or change of hair, feathers, skins, horns, or other parts of animals, happening in some annually, in others only at certain stages of life.

The generality of animals moult in the spring. The moulting of a hawk is called *mewing*. The moulting of a deer is the quitting of his horns in February or March. The moulting of a serpent is the putting off his skin. See EXUVIÆ.

MOUND, a term used for a bank or rampart, or other fence, particularly that of earth.

MOUND, in *Heraldry*, a ball or globe with a cross upon it, such as our kings are usually drawn with, holding it in their left hand, as they do the sceptre in the right.

MOUNT, an elevation of earth, called also *mountain*. See MOUNTAIN.

MOUNT Edgecumbe, a prodigious high peak, at the entrance of Cook's strait, in New Zealand, on the west side. Its height is supposed not to be much inferior to that of the Peak of Teneriffe.

MOUNT Sorrel, a town in Leicestershire, so named from a high mount or solid rock adjoining to the town, of a dusky red or sorrel-coloured stone, extremely hard. Of rough stones hewn out of this rock the town is built. It was noted formerly for its castle, and is seated on the river Stour, over which there is a bridge. It is 20 miles south-east by south of Derby, and 105 north-west by north of London. It contained 1502 inhabitants in 1811. W. Long. 1. 9. N. Lat. 52. 45.

MOUNTS of Piety, certain funds or establishments in Italy, where money is lent out on some small security. There were also mounts of piety in England, raised by contribution for the benefit of people ruined by the extortions of the Jews.

MOUNTAIN (*Mons*), a considerable eminence of land, elevated above the surrounding country: It is commonly full of inequalities, cavities more or less exposed, and strata uncovered. For the natural history of mountains, see MOUNTAIN, GEOLOGY *Index*.

Attraction of MOUNTAINS. This is a late discovery, and a very considerable confirmation of Sir Isaac Newton's theory of universal gravity. According to the Newtonian system, an attractive power is not only exerted between those large masses of matter which constitute the sun and planets, but likewise between all comparatively smaller bodies, and even between the smallest particles of which they are composed. Agreeably to this hypothesis, a heavy body, which ought to gravitate or tend toward the centre of the earth, in a direction perpendicular to its surface, supposing the said surface to be perfectly even and spherical, ought likewise, though in a less degree, to be attracted and tend towards a mountain placed on the earth's surface; so that a plumb line, for instance, of a quadrant, hanging in the neighbourhood of such a mountain, ought to be drawn from a perpendicular situation, in consequence of the attractive power of the quantity of matter of which it is composed acting in a direction different from that exerted by the whole mass of matter in the earth, and with a proportionably inferior degree of force. Mountain.

Though Sir Isaac Newton had long ago hinted at an experiment of this kind, and had remarked, that "a mountain of an hemispherical figure, three miles high and six broad, would not, by its attraction, draw the plumb line two minutes out of the perpendicular (E):" yet no attempt to ascertain this matter by actual experiment was made till about the year 1738; when the French academicians, particularly Messrs Bouguer and Condamine, who were sent to Peru to measure a degree under the equator, attempted to discover the attractive power of Chimboraço, a mountain in the province of Quito. According to their observations, which were however made under circumstances by no means favourable to an accurate solution of so nice and difficult a problem, the mountain Chimboraço exerted an attraction equal to eight seconds. Though this experiment was not perhaps sufficient to prove satisfactorily even the reality of an attraction, much less the precise quantity of it; yet it does not appear that any steps had been since taken to repeat it.

Through the munificence of his Britannic majesty, the Royal Society were enabled to undertake the execution of this delicate and important experiment; the astronomer royal was chosen to conduct it. After various inquiries, the mountain Schehallien, situated nearly in the centre of Scotland, was pitched upon as the most proper for the purpose that could be found in this island. The observations were made by taking the meridian zenith distances of different fixed stars, near the zenith, by means of a zenith sector of ten feet radius; first on the south, and afterwards on the north side of the hill, the greatest length of which extended in an east and west direction.

It is evident, that if the mass of matter in the hill exerted any sensible attraction, it would cause the plumb-line of the sector, through which an observer viewed a star in the meridian, to deviate from its perpendicular situation, and would attract it contrariwise at the

(E) By a very easy calculation it is found that such a mountain would attract the plumb line 1′ 18″ from the perpendicular.

Mountains. the two stations, thereby doubling the effect. On the south side the plummet would be drawn to the northward by the attractive power of the hill placed to the northward of it: and on the north side, a contrary and equal deflection of the plumb line would take place in consequence of the attraction of the hill, now to the southward of it. The apparent zenith distances of the stars would be affected contrariwise; those being increased at the one station which were diminished at the other: and the correspondent quantities of the deflection of the plumb line would give the observer the sum of the contrary attractions of the hill, acting on the plummet at the two stations; the half of which will of course indicate the attractive power of the hill.

The various operations requisite for this experiment lasted about four months; and from them it appears that the sum of the two contrary attractions of the mountain Schehallien, in the two temporary observations which were successively fixed half way up the hill (where the effect of its attraction would be greatest), was equal to 11″.6.—From a rough computation, founded on the known law of gravitation, and on an assumption that the density of the hill is equal to the mean density of the earth, it appears that the attraction of the hill should amount to about the double of this quantity. From thence it was inferred that the density of the hill is only about half the mean density of the earth. It does not appear, however, that the mountain Schehallien has ever been a volcano, or is hollow; as it is extremely solid and dense, and seemingly composed of an entire rock.

The inferences drawn from these experiments may be reduced to the following:

"1. It appears, that the mountain Schehallien exerts a sensible attraction; therefore, from the rules of philosophizing, we are to conclude, that every mountain, and indeed every particle of the earth, is endued with the same property, in proportion to its quantity of matter.

"2. The law of the variation of this force, in the inverse ratio of the squares of the distances, as laid down by Sir Isaac Newton, is also confirmed by this experiment. For if the force of attraction of the hill had been only to that of the earth, as the matter in the hill to that of the earth, and had not been greatly increased by the near approach to its centre, the attraction thereof must have been wholly insensible. But now, by only supposing the mean density of the earth to be double to that of the hill, which seems very probable from other considerations, the attraction of the hill will be reconciled to the general law of the variation of attraction in the inverse duplicate ratio of the distances, as deduced by Sir Isaac Newton from the comparison of the motion of the heavenly bodies with the force of gravity at the surface of the earth; and the analogy of nature will be preserved.

"3. We may now, therefore, be allowed to admit this law, and to acknowledge, that the mean density of the earth is at least double of that at the surface; and consequently that the density of the internal parts of the earth is much greater than near the surface. Hence also, the whole quantity of matter in the earth will be at least as great again, as if it had been all composed of matter of the same density with that at the surface; or will be about four or five times as great as if it were all composed of water.—This conclusion, Mr Maskelyne adds, is totally contrary to the hypothesis of some naturalists, 'who suppose the earth to be only a great hollow shell of matter; supporting itself from the property of an arch, with an immense vacuity in the midst of it.' But were that the case, the attraction of mountains, and even smaller inequalities in the earth's surface would be very great, contrary to experiment, and would affect the measures of the degrees of the meridian much more than we find they do; and the variation of gravity, in different latitudes, in going from the equator to the poles, as found by pendulums, would not be near so regular as it has been found by experiment to be. Mountains

"4. As mountains are by these experiments found capable of producing sensible deflections of the plumb lines of astronomical instruments; it becomes a matter of great importance, in the mensuration of degrees in the meridian, either to choose places where the irregular attraction of the elevated parts may be small; or where, by their situation, they may compensate or counteract the effects of each other." See MOUNTAINS, SUPPLEMENT.

For measuring the heights of mountains, see BAROMETER.

Burning MOUNTAINS. See ÆTNA, HECLA, VESUVIUS; see also VOLCANO, GEOLOGY *Index.*

Marble MOUNTAINS. Of these there are great numbers in Egypt, from which, though immense quantities have been carried off for the multitude of great works erected by the ancient Egyptians; yet in the opinion of Mr Bruce, who passed by them in his journey to Abyssinia, there is still a sufficient supply to build Rome, Athens, Corinth, Syracuse, Memphis, Alexandria, and half a dozen more of such cities.

The first mountain of this kind mentioned by Mr Bruce is one opposite to Terfowey, consisting partly of green marble, partly of granite, with a red blush upon a gray ground, and square oblong spots. Here he saw a monstrous obelisk of marble very nearly square, broken at the end, and nearly 30 feet long and 19 feet in the face. Throughout the plain there were scattered small pieces of jasper, with green, white, and red spots, called in Italy *diaspro sanguinco;* and all the mountains upon that side seemed to consist of the same materials. From Mr Bruce's description of these mountains, it would appear that they are composed of serpentine, and not of calcareous marble.

Written MOUNTAIN, Mountain of Inscriptions, or *Jibel-al-Mokatteb,* a supposed mountain or chain of mountains, in the wilderness of Sinai; on which, for a great extent of space, the marble of which the mountain consists is inscribed with innumerable characters, reaching from the ground sometimes to the height of 12 or 14 feet. These were mentioned by a Greek author in the third century, and some of them have been copied by Pococke and other late travellers; but, after all, there is still a very great uncertainty even of the *existence* of such mountain or mountains. The vast number of these inscriptions, the desert place in which they are found, and the length of time requisite for executing the task, have induced a notion by no means unnatural, that they are the work of the Israelites during their forty years wandering in the wilderness. Others are of opinion that they contain nothing of any

importance,

Mountains. importance, but consist merely of the names of travellers and the dates of their journeys.

M. Niebuhr, who visited this country during his travels in the east, made every attempt in his power, though without success, to obtain a sight of this celebrated mountain. On applying to some Grecks at Suez, they all declared that they knew nothing of the written mountain: they, however, directed him to an Arabian sheik, who had passed all his lifetime in travelling between Suez and Mount Sinai; but he knew no more of it than the former. Understanding, however, that a considerable reward would be given to any person who would conduct them thither, this Arab directed them to another; who pretended not only to know that mountain, but all others upon which there were any inscriptions throughout the desert. On inquiring particularly, however, our travellers found that he was not to be depended upon; so that they were obliged to have recourse to a fourth sheik, who by his conversation convinced them that he had seen mountains with inscriptions in unknown characters upon them. It does not appear, however, that this person was very capable, more than the rest, of leading them to the place they so much wished for; though he conducted them to some rocks upon which there were inscriptions in unknown characters. They are most numerous in a narrow pass between two mountains named *Om-er-ridstein;* and, says M. Niebuhr, "the pretended Jibel-el-Mokatteb may possibly be in its neighbourhood." Some of these inscriptions were copied by our author; but he does not look upon them to be of any consequence. "They seem (says he) to have been executed at idle hours by travellers, who were satisfied with cutting the unpolished rock with any pointed instrument, adding to their names and the date of their journeys some rude figures, which bespeak the hand of a people but little skilled in the arts. When such inscriptions are executed with the design of transmitting to posterity the memory of such events as might afford instructive lessons, greater care is generally taken in the preparation of the stones, and the inscriptions are engraven with more regularity."

When M. Niebuhr arrived at last at the mountain to which the sheik had promised to conduct him, he did not find any inscriptions; but on climbing up to the top, he found out an Egyptian cemetery, the stones of which were covered with hieroglyphics. The tomb stones are from five to seven feet in length, some standing on end and others lying flat; and "the more carefully they are examined (says he), the more certainly do they appear to be sepulchral stones, having epitaphs inscribed on them. In the middle of the stones is a building, of which only the walls now remain; and within it are likewise a great many of the sepulchral stones. At one end of the building seems to have been a small chamber, of which the roof still remains. It is supported upon square pillars; and these, as well as the walls of the chamber, are covered with hieroglyphic inscriptions. Through the whole building are various busts executed in the manner of the ancient Egyptians. The sepulchral stones and the busts are of hard and fine grained sand stone." M. Niebuhr is of opinion that this cemetery was not the work of the Egyptians themselves, but of some colony which came from Egypt, and had adopted the manners and customs of the people. He supposes that it might have been built by the Arabs, who had conquered Egypt under the shepherd kings, and adopted the Egyptian manners during their residence there. As it must have belonged to an opulent city, however, he owns that there is a great difficulty in accounting for the existence of such a city in the midst of a desert. Mountains.

The translator of Volney's travels ascribes these inscriptions to the pilgrims who visit Mount Sinai. But to this, as well as to every other conjecture, there is this objection, that whether the inscriptions be well executed or not, whether they contain matters of importance or not, they ought to have been written in a language which *somebody* could understand; but from the copies that have been taken of them by Dr Pococke and others, it does not appear that they could be explained either by him or any other person.

When Dr Clayton, bishop of Clogher, visited this part of the world about the year 1723, he expressed the greatest desire to have the matter concerning this written mountain or mountains ascertained, and even made an offer of 500l. sterling to any literary person who would undertake the journey and endeavour to decypher the inscriptions; but no such person has appeared, and the existence of the mountains is testified only by the superior of a convent at Cairo, who gave that mentioned in the beginning of this article. Until that part of the world, therefore, become more accessible to travellers, there is but little hope that we can come to any certainty in the matter. M. Niebuhr plainly, from his own accounts, had not influence enough with the Arabs to show him almost any thing, as they refused to conduct him even to the summit of Mount Sinai.

White Mountains. See *New* Hampshire.

Mountains of the Moon, a chain of mountains in Africa, extending between Abyssinia and Monomotapa, and so called from their great height.

Mountains of the Lions, also in Africa, divide Nigritia from Guinea, and extend as far as Ethiopia. They were styled by the ancients *the mountains of God*, on account of their being greatly subject to thunder and lightning.

Mountain of Forty Days; a mountain of Judea, situated in the plain of Jericho, to the north of that city. According to the abbé Mariti's description, the summit of it is covered neither with shrubs, turf, nor earth; it consists of a solid mass of white marble, the surface of which is become yellow by the injuries of the air. "The path by which you ascend to it (says our author) fills one with terror, as it rises with a winding course between two abysses, which the eye dares scarcely behold. This path is at first pretty broad, but it at length becomes so confined, that one can with difficulty place both feet upon it at the same time. When we had ascended a little higher, we found an Arab stretched out on the path, who made us pay a certain toll for our passage. Here the traveller requires courage. One of the parapets of the path being broke, we clung to the part which remained until we had reached a small grotto, situated very commodiously, as it gave us an opportunity of recovering our breath. When we had rested ourselves a little, we pursued our course, which became still more dangerous. Suspended almost from the rock, and having before our eyes all the horror of the

Mountain, Mourning.

the precipice, we could advance only by dragging one foot after the other; so that had the smallest fragments given way under us, we should have been hurried to the bottom of this frightful abyss.

"This mountain is one of the highest in the province, and one of its most sacred places. It takes its name from the rigorous fast which Christ observed here after having triumphed over the vanities of the world and the power of hell. In remembrance of this miracle, a chapel was formerly constructed on the summit of the mountain. It may be seen from the plain, but we could not approach it, as the path was almost entirely destroyed. It, however, may be accessible on the other side of the mountain, which we did not visit. A great many scattered grottos are seen here; in one of which, according to Quaresmius, were deposited the bodies of several anchorets, which are still entire. I have heard the same thing asserted in the country, but I could never meet with any person who had seen them. Here we enjoyed the most beautiful prospect imaginable. This part of the mountain of Forty Days overlooks the mountains of Arabia, the country of Gilead, the country of the Ammonites, the plains of Moab, the plain of Jericho, the river Jordan, and the whole extent of the Dead sea. It was here that the devil said to the Son of God, 'All these kingdoms will I give thee, if thou wilt fall down and worship me."

MOURNING, a particular dress or habit worn to signify grief on some melancholy occasion, particularly the death of friends or of great public characters.—The modes of mourning are various in various countries; as also are the colours that obtain for that end. In Europe, the ordinary colour for mourning is black; in China, it is white; in Turkey, blue or violet; in Egypt, yellow; in Ethiopia, brown. White obtained formerly in Castile on the death of their princes. Herrera observes, that the last time it was used was in 1498, at the death of Prince John. Each people pretend to have their reasons for the particular colour of their mourning; white is supposed to denote purity; yellow, that death is the end of human hopes, in regard that leaves when they fall, and flowers when they fade, become yellow: brown denotes the earth, whither the dead return; black, the privation of life, as being the privation of light: blue expresses the happiness which it is hoped the deceased does enjoy; and purple or violent, sorrow on the one side, and hope on the other, as being a mixture of black and blue.

MOURNING, among the ancients, was expressed various ways.

Amongst the Jews, on the death of their relations or intimate friends, grief or mourning was signified by weeping, tearing their clothes, smiting their breasts, or tearing them with their nails, pulling or cutting off their hair and beards, walking softly, i. e. barefoot, lying upon the ground, fasting, or eating upon the ground. They kept themselves close shut up in their houses, covered their faces, and abstained from all work, even reading the law, and saying their usual prayers. They neither dressed themselves, nor made the beds, nor shaved themselves, nor cut their nails, nor went into the bath, nor saluted any body: so that sulkiness seems to have been an indication of sorrow, and dirtiness of distress. The time of mourning among the Jews was generally seven days: though this was lengthened or shortened according to circumstances; but 30 days were thought sufficient upon the severest occasions. The different periods of the time of mourning required different degrees of grief, and different tokens of it. Mourning.

The Greeks, on the death of friends, showed their sorrow by secluding themselves from all gaiety, entertainments, games, public solemnities, the enjoyment of wine, and the delights of music. They sat in gloomy and solitary places, stripped themselves of all external ornaments, put on a coarse black stuff by way of mourning, tore their hair, shaved their heads, rolled themselves in the dust and mire, sprinkled ashes on their heads, smote their breasts with their palms, tore their faces, and frequently cried out with a lamentable voice and drawling tone, reiterating the interjection ε, ε, ε, ε; hence funeral lamentations were called Ελεγοι. If they appeared in public during the time of mourning, they had a veil thrown over their faces and heads. During the funeral procession, certain persons called εξαρχοι θρηνων, marched before, and sung melancholy strains called ολολυγμοι Ιαλεμοι, Αινοι, and Αιλινοι. These vocal mourners sung thrice during the procession round the pile and round the grave. Flutes were also used to heighten the solemnity. At the funerals of soldiers, their fellow soldiers who attended, as a testimony of their affliction, held their shields, their spears, and the rest of their armour, inverted.

The tokens of private grief among the Romans were the same as those already observed as customary among the Greeks. Black or dark brown were the colours of the mourning habits worn by the men; they were also common to the women. The mourning of the emperors at first was black. In the time of Augustus, the women wore white veils, and the rest of their dress black. From the time of Domitian they wore nothing but white habits, without any ornaments of gold, jewels, or pearls. The men let their hair and beards grow, and wore no wreaths of flowers on their heads while the days of mourning continued. The longest time of mourning was ten months: this was Numa's establishment, and took in his whole year. For a widow to marry during this time was infamous. Mourning was not used for children who died under three years of age. From this age to ten they mourned as many months as the child was years old. A remarkable victory, or other happy event, occasioned the shortening of the time of mourning: The birth of a child, or the attainment of any remarkable honour in the family, certain feasts in honour of the gods, or the consecration of a temple, had the same effect. After the battle of Cannæ, the commonwealth decreed that mourning should not be worn for more than 30 days, that the loss might be forgotten as soon as possible. When public magistrates died, or persons of great note, also when any remarkable calamity happened, all public meetings were intermitted, the schools of exercise, baths, shops, temples, and all places of concourse were shut up, and the whole city put on a face of sorrow; the senators laid aside the *laticlave*, and the consuls sat in a lower seat than ordinary. This was the custom of Athens also, and was observed upon the death of Socrates not long after he had been sentenced to death by their judges.

Præficæ, or mourning women, (by the Greeks called θρηνων εξαρχοι), went about the streets: this was customary

Mourning || Mousul.

mary among the Jews as well as the Greeks and Romans, (Jerem. ix. 17.)

MOUSE. See Mus, Mammalia *Index*.

Mouse-Ear. See Hieracium, } Botany *Index*.
Mouse-Tail. See Myosurus, }

Dor-Mouse. See Myoxus, } Mammalia *Index*.
Shrew-Mouse. See Sorex, }

MOUSELLE, the name of an East Indian tree, with white tubular flowers, which fall off every day in great plenty. They are of a sweet agreeable smell, and the Gentoos are very fond of wearing them, stringing and hanging them about their necks and arms. The fruit is a pale red cherry, of the shape and size of our white heart cherry, but the footstalk is not quite so long. This fruit has a stone in it, containing a bitter oily kernel. The Indians rub with this oil any part stung by a scorpion or bitten by a centipede, which it soon cures. The crows are very fond of the fruit.

MOUSUL, or Mosul, a large city of Turkey in Asia, and capital of a beglerbegate, stands on the west bank of the Tigris, in the latitude, according to Mr Ives's observation, of 36° 30′ north. It is surrounded with stone walls, but has many of its streets lying waste. Tavernier speaks of it as a ruined place, with only two blind markets and a sorry castle; yet, he says, that it is much frequented by merchants, and that its basha commands 3000 men. There is a bridge of boats over the Tigris; and the city is a thoroughfare from Persia to Syria, which makes it a place of trade, and which is more augmented by a constant traffic from this place to Bagdad. The country on this side the river is sandy and barren; but on the opposite side it is exceedingly fruitful, yielding good crops of corn and fruit in abundance. Mr Ives says it was the best built city he had seen in Turkey; but had nothing in it to attract the notice of an European. It was besieged for near six months by Nadir Shah without success. Breaches were frequently made in the walls, and assaults continued for three days successively; but the assailants were constantly repulsed, and the breaches made in the day time repaired during the night. The besieged had unanimously resolved to die rather than to submit. The Turks declared, that should the place be forced to surrender, they were determined to put to death all their wives and daughters first, that they might not fall into the vile hands of the abhorred Persians. The place was therefore defended with uncommon bravery; even the women and children exerted themselves with the greatest alacrity. The Christians behaved in such a manner as to gain the esteem and admiration of the other inhabitants; and some of their churches being demolished, they were afterwards repaired at the expence of government.

In this city there are a great many mosques, the largest and most stately of which is ornamented on the top with green tiles. At the doors of these houses there are usually inscriptions in gilt letters, declaring the awfulness of the building, as being the house of God. One of them has a minaret which bends like those of Bagdad. Some of the most bigotted Turks say, that Mahomet saluted this minaret as he passed; on which it bent its head in reverence to the prophet, and ever after continued in that situation. The manufacture of this city is *mussolen* (muslin), which is made very strong and pretty fine. In the year 1757, this city and the country adjacent were visited by a dreadful famine, owing to the preceding hard winter, and innumerable multitudes of locusts, by which the fruits of the earth were destroyed. When Mr Ives was there in 1758, the country was comparatively depopulated. Almost all the brute creation had been destroyed for the subsistence of man. During the famine, the people had eaten dogs, and every kind of animal which is held in abhorrence at any other time, not sparing even their own children; and the dead bodies lay in the streets for want of people to bury them. Their fruit trees were also destroyed by the frost; so that when our author was there scarcely any fruit could be had. The neighbouring mountains afford silver mines; and they would yield much quicksilver if the Turks had either the skill or inclination to work them to advantage. Lanza says, that some time ago an Englishman who travelled through this country got two or three bottles of it, which he presented to the basha as a specimen of what might be done in that way: but no farther attempt was made. Here also are some lead mines, which supply as much of that metal as furnishes them with bullets and some necessary utensils.

Mousul || Mouth.

MOU-TAN or Peony Shrub of China: also called *hóa-cuang*, or "the king of flowers," and *pekang-kin*, "an hundred ounces of gold," in allusion to the excessive price given formerly by some of the virtuosi for certain species of this plant. The mou-tan seems to claim pre-eminence, not only on account of the splendour and number of its flowers, and of the sweet odour which they diffuse around, but also on account of the multitude of leaves which compose them, and of the beautiful golden spots with which they are interspersed. This plant, which is of a shrubby nature, shoots forth a number of branches, which form a top almost as large as those of the finest orange trees.

MOUTH, in *Anatomy*, a part of the face, consisting of the lips, the gums, the insides of the cheeks, the palate, the salival glands, the os hyoides, the uvula, and the tonsils; which see under the article Anatomy.

Mr Derham observes, that the mouth in the several species of animals is nicely adapted to the uses of such a part, and well sized and shaped for the formation of speech, the gathering and receiving of food, the catching of prey, &c. In some creatures it is wide and large, in others little and narrow; in some it is formed with a deep incisure into the head, for the better catching and holding of prey, and more easy comminution of hard, large, and troublesome food; and in others with a shorter incisure, for the gathering and holding of herbaceous food. In birds it is neatly shaped for piercing the air; hard and horny, to supply the want of teeth; hooked, in the rapacious kind, to catch and hold their prey; long and slender in those that have their food to grope for in moorish places; and broad and long in those that search for it in the mud. Nor is the mouth less remarkable in insects; in some it is forcipated, to catch, hold, and tear the prey; in others aculeated, to pierce and wound animals, and suck their blood; in others, strongly rigid, with jaws and teeth, to gnaw and scrape

Mouth || Muffle.

out their food, carry burdens, perforate the earth, nay the hardest wood, and even stones themselves, for houses and nests for their young.

MOWEE, one of the Sandwich islands, discovered by Captain Cook, is 162 miles in circumference. A low isthmus divides it into two circular peninsulas, of which the eastern is double the size of the western. The mountains in both rise to a great height, and may be seen at the distance of more than 30 leagues. The northern shores, like those of Owhyhee, afford no soundings, and the country presents the same appearance of verdure and fertility. The number of inhabitants is computed at about 65,000. W. Long. 175. 56. N. Lat. 20. 53.

MOXA, or MUGWORT of China, is a soft lanuginous substance, prepared in Japan from the young leaves of a species of ARTEMISIA, by beating them together when thoroughly dried, and rubbing them betwixt the hands till only the fine fibres are left. The down on the leaves of mullein, cotton, hemp, &c. answers the same purpose.

In the Eastern countries it is used by burning it on the skin: a little cone of the moxa is laid upon the part, previously moistened, and set on fire at the top; it burns down with a temperate glowing heat, and produces a dark coloured spot, the exulceration of which is promoted by applying a little garlic; the ulcer is left to discharge, or is soon healed, according to the intention in using the moxa.

MOYRA. See MOIRA.

MUCILAGE, in *Pharmacy*, is in general any viscid or glutinous liquor.

MUCILAGE also imports the liquor which principally serves to moisten the ligaments and cartilages of the articulations, and is supplied by the mucilaginous glands.

MUCOR, in *Botany*, a genus of the order of fungi, belonging to the cryptogamia class of plants. See BOTANY *Index*.

MUCUS, a mucilaginous liquor secreted by certain glands, and serving to lubricate many of the internal cavities of the body. In its natural state it is generally limpid and colourless; but, from certain causes, assumes a thick consistence and a whitish colour like pus. For the distinguishing characters between pus and mucus, see CHEMISTRY, N° 2769.

MUCK, or RUNNING A MUCK, is a practice that has prevailed time immemorial in Batavia. To run a muck, in the original sense of the word, is to get intoxicated with opium, and then rush into the street with a drawn weapon, and kill any one that comes in the way, till the party is himself either killed or taken prisoner. If the officer take one of these *amocks* or *mohawks* (as they have been called by an easy corruption) alive, he has a considerable reward; and the unhappy wretch is always broken alive on the wheel: but such is the fury of their desperation, that three out of four are necessarily destroyed in attempting to secure them.

MUD-IGUANA. See MURÆNA, ICHTHYOLOGY *Index*.

MUFFLE, in *Chemistry*, a vessel employed in some metallurgic operations. In figure it represents an oblong arch or vault, the hinder part of which is closed by a semicircular plane, and the lower part or floor of which is a rectangular plane. It is a little oven that is placed horizontally in assay and enamelling furnaces, so that its open side corresponds with the door of the fire-place of the furnace. Under this arched oven small cupels or crucibles are placed; and the substances contained are thus exposed to intense heat without contact of fuel, smoke, or ashes.

Muffle || Mulberry.

MUFTI, the chief of the ecclesiastical order, or primate of the Mussulman religion. The authority of the mufti is very great in the Ottoman empire; for even the sultan himself, if he would preserve any appearance of religion, cannot, without hearing his opinion, put any person to death, or so much as inflict any corporal punishment. In all actions, especially criminal ones, his opinion is required, by giving him a writing in which the case is stated under feigned names; which he subscribes with the words, *He shall*, or *shall not*, *be punished*. Such outward honour is paid to the mufti, that the grand signior himself rises up to him, and advances seven steps to meet him when he comes into his presence. He alone has the honour of kissing the sultan's left shoulder, whilst the prime vizier kisses only the hem of his garment. When the grand signior addresses any writing to the mufti, he gives him the following titles: *To the Esad, the wisest of the wise, instructed in all knowledge, the most excellent of excellents, abstaining from things unlawful, the spring of virtue and of true science, heir of the prophetic doctrines, resolver of the problems of faith, revealer of the orthodox articles, key of the treasures of truth, the light to the doubtful allegories, strengthened with the grace of the supreme Legislator of mankind, may the Most High God perpetuate thy virtues!* The election of the mufti is solely in the grand signior, who presents him with a vest of rich sables, &c. If he is convicted of treason or any great crime, he is put into a mortar kept for that purpose in the Seven Towers at Constantinople, and pounded to death.

MUGGLETONIANS, a religious sect which arose in England about the year 1657; so denominated from their leader Lodowick Muggleton, a journeyman taylor, who, with his associate Reeves, set up for great prophets, pretending, as it is said, to have an absolute power of saving and damning whom they pleased; and giving out that they were the two last witnesses of God that should appear before the end of the world.

MUGIL, the MULLET, a genus of fishes belonging to the order of abdominales. See ICHTHYOLOGY *Index*.

MUGWORT, a species of ARTEMISIA; which see, BOTANY *Index*.

MUID, a large measure in use among the French, for things dry. The muid is no real vessel used as a measure, but an estimation of several other measures; as the septier, mine, minot, bushel, &c.

MUID, is also one of the nine casks, or regular vessels used in France, to put wine and other liquors in. The muid of wine is divided into two demi-muids, four quarter-muids, and eight half-quarter muids, containing 36 septiers.

MULATTO, a name given in the Indies to those who are begotten by a negro man on an Indian or white woman, or by an Indian or white man on a negro woman.

MULBERRY. See MORUS, BOTANY *Index*.

MULBERRY-Cyder, a name given by the people of Devonshire, and some other parts of England, to a sort

Mulberry || Mulier.

sort of cyder rendered very palatable by an admixture of mulberry juice in the making; they choose for this purpose the ripest and blackest mulberries, and pressing out their juice, and mixing it with a full bodied cyder at the time of the grinding and pressing, give just so much of it as adds a perceptible flavour. It is very worthy the attention of people who live in other countries, where strong and good cyder is made, that this renders it a sort of wine much more agreeable than any other English liquor, and might be brought into general use, to the great advantage of the dealer. The colour of this liquor resembles that of the brightest red wine, and the flavour of the mulberry never goes off. Phil. Trans. N° 133.

MULCT, a fine of money laid upon a man who has committed some fault or misdemeanour.

MULE, a mongrel kind of quadruped, usually generated between an ass and a mare, and sometimes between a horse and a she ass; but the signification of the word is commonly extended to every kind of animal produced by a mixture of two different species. See MAMMALIA *Index*.

MULES, among gardeners, denote a sort of vegetable monsters produced by putting the farina fœcundans of one species of plant into the pistil or utricle of another.

The carnation and sweet-william being somewhat alike in their parts, particularly their flowers, the farina of the one will impregnate the other, and the seed so cultivened will produce a plant differing from either. An instance of this we first had in Mr Fairchild's garden at Hoxton; where a plant is seen neither sweet-william nor carnation, but resembling both equally: this was raised from the seed of a carnation that had been impregnated by the farina of the sweet-william. These couplings being not unlike those of the mare with the ass, which produce the mule, the same name is given them; and they are, like the others, incapable of multiplying their species.

This furnishes a hint for altering the property and taste of any fruit, by impregnating one tree with the farina of another of the same class; *e.gr.* a codlin with a pear-main, which will occasion the codlin so impregnated to last a longer time than usual, and to be of a sharper taste.

MULHAUSEN, an imperial and Hanseatic town of Germany, in Upper Saxony, and in Thuringia, under the protection of the elector of Saxony; seated in a fertile country, on the river Unstrutht, 15 miles north-east of Eisenach, and 45 east by south of Cassel. E. Long. 10. 49. N. Lat. 51. 13.

MULHAUSEN, a considerable town in Alsace, formerly capital of a republic in alliance with the Swiss. It is populous, and well built, seated in a pleasant fertile country, on an island formed by the river Ill, 15 miles north-west of Basle. It was united to France in 1798, and belongs to the department of the Upper Rhine. E. Long. 7. 24. N. Lat. 47. 48.

MULIER, in *Law*, signifies the lawful issue born in wedlock, though begotten before. The mulier is preferred to an older brother born out of matrimony; as for instance, if a man has a son by a woman before marriage, which issue is a bastard, and afterwards marries the mother of the bastard, and they have another son, this second son is mulier and lawful, and shall be heir of the father; but the other can be heir to no person*. By the civil law, where a man has issue by a woman, if after that he marries her, the issue is mulier.

Mulier || Mullingar.

* See the article *Bastard*.

MULL, one of the Western islands of Scotland, about 25 miles long, and as much in breadth. It is in general rocky and barren, not producing a sufficient quantity of corn for the inhabitants; but a great number of cattle are annually exported, which with the fishings and a considerable quantity of kelp are the only articles of commerce. It is deeply indented with bays and creeks, forming in several parts good natural harbours. There are no villages except Tobermorey, near the northern point of the island, where a fishing station has been fixed. The island was originally part of the dominions of the Lords of the Isles; but in after times it became a part of the possessions of the ancient family of Macleans, who still retain a considerable part. The duke of Argyll is also a considerable proprietor. The ruins of several ancient castles are seen on this island. The population of Mull, in 1795, amounted to about 8000 persons.

Mull of Cantyre. See CANTYRE.

Mull of Galloway. See GALLOWAY.

MULLEIN. See VERBASCUM, BOTANY *Index*.

MULLER, or REGIOMONTANUS, JOHN, a celebrated astronomer of the 15th century, was born at Koningshoven in Franconia in 1436, and acquired great reputation by publishing an abridgement of Ptolemy's Almagest, which had been begun by Purback. He went to Rome to perfect himself in the Greek tongue, and to see the Cardinal Bassarion; but finding some faults in the Latin translation of George de Trebizond, that translator's son assassinated him in a second journey he made to Rome in 1476, where Pope Sixtus IV. had provided for him the archbishopric of Ratisbon, and had sent for him to reform the calendar. Others say that he died of the plague.

MULLER, or *Mullar*, denotes a stone flat and even at bottom, but round a-top; used for grinding of matters on a marble.—The apothecaries use mullers to prepare many of their testaceous powders; and painters for their colours, either dry or in oil.

MULLER is an instrument used by the glass-grinders; being a piece of wood, to one end whereof is cemented the glass to be ground, whether convex in a bason, or concave in a sphere or bowl.—The muller is ordinarily about six inches long, turned round: the cement used is composed of ashes and pitch. See GRINDING.

MULLERAS, a town of Germany, in the circle of Upper Saxony, and marquisate of Brandenburg, seated 38 miles south of Berlin, upon a canal which joins the Oder and the Spree. This canal is 15 miles in length, 10 yards in breadth, and seven feet in depth. It was eight years in making; and since that time the cities of Hamburg and Breslaw have carried on great trade by water. E. Long. 14. 50. N. Lat. 52. 21.

MULLET. See MUGIL, ICHTHYOLOGY *Index*.

MULLET, or *Mollet*, in *Heraldry*, a bearing in form of the rowel of a spur, which it originally represented.

MULLINGAR, the county town of Westmeath, and province of Leinster, in Ireland, 38 miles from

Mullingar || Mum.

Dublin. N. Lat. 53. 30. W. Long. 7. 50. Within a few miles of it are the ruins of the church, and also those of a castle. It is situated on the river Feyle. It holds a great wool fair, and is a place of good trade. In 1227, the priory of St Mary, formerly known by the name of *The House of God of Mullingar*, was founded here by Ralph de Petyt bishop of Meath, for regular canons of the order of St Augustin. A Dominican friary was also founded here in 1237 by the family of Nugent; some ruins of which still remain. In 1622, the friars of Multifarnham began to erect a house there for friars of the order of St Francis, but it was never completed.

MULLUS, the SURMULLET, a genus of fishes belonging to the order of thoracici. See ICHTHYOLOGY *Index*.

MULTIPLE, in *Arithmetic*, a number which comprehends some other several times; thus 6 is a multiple of 2, and 12 is a multiple of 6, 4, and 3; comprehending the first twice, the second thrice, &c.

Action of MULTIPLEPOINDING, in *Scots Law*. See LAW, N° clxxxiii. 24.

MULTIPLICAND, in *Arithmetic*, the number to be multiplied by another. See ARITHMETIC.

MULTIPLICATION, in general, the act of increasing the number of any thing.

MULTIPLICATION, in *Arithmetic*, is a rule by which any given number may be speedily increased, according to any proposed number of times. See ARITHMETIC.

MULTIPLICATION, in *Algebra*. See ALGEBRA.

MULTIPLICATOR, or MULTIPLIER, in *Arithmetic*, the number by which any other is multiplied, or the number of times it is supposed to be taken.

MULTIPLICATUS FLOS, a luxuriant flower, whose petals are multiplied so as to exclude a part or the whole of the stamina.

MULTIPLYING GLASS, in *Optics*, a glass wherewith objects appear increased in number. See OPTICS.

MULTURE in *Scots Law*, a certain stipulated quantity of meal given as payment to the proprietor or tacksman of a mill for grinding the corn: and all corn ground on farms thirled to the mill is obliged to pay multure whether the corn be ground at that mill or elsewhere.

MULVIA, a river of Barbary in Africa, which rises in the mountains of Atlas, and divides the empire of Morocco from that of Algiers, and then falls into the Mediterranean, to the westward of Marsalquiver.

MUM, a kind of malt liquor much drunk in Germany, and chiefly brought from Brunswick, which is the place of most note for making it. The process of brewing mum, as recorded in the townhouse of that city, is as follows: Take 63 gallons of water that has been boiled till one third part is consumed, and brew it with seven bushels of wheaten malt, one bushel of oat meal, and one bushel of ground beans. When it is tunned, the hogshead must not be filled too full at first: as soon as it begins to work, put into it three pounds of the inner rind of fir, one pound of the tops of fir and beech, three handfuls of carduus benedictus, a handful or two of the flower of rosa solis: add burnet, betony, marjoram, avens, pennyroyal, and wild thyme, of each a handful and a half; of elder flowers, two handfuls or more; seeds of cardamon bruised, 30 ounces; barberries bruised, one ounce: when the liquor has worked a while, put the herbs and seeds into the vessel; and, after they are added, let it work over as little as possible; then fill it up: lastly, when it is stopped, put into the hogshead ten new-laid eggs unbroken; stop it up close, and use it at two years end. The English brewers, instead of the inner rind of fir, use cardamom, ginger, and sassafras; and also add elecampane, madder, and red sanders.

Mum || Mummy.

MUMMIUS, L. a Roman consul sent against the Achæans, whom he conquered B. C. 147. He destroyed Corinth, Thebes, and Chalcis, by order of the senate, and obtained the surname of *Achaicus* from his victories. He did not enrich himself with the spoils of the enemy, but returned home without any increase of fortune. He was so little acquainted with the value of the paintings and works of the most celebrated artists of Greece which were found in the plunder of Corinth, that he said to those who conveyed them to Rome, that if they lost or injured them, they should makes others in their stead.

MUMMY, a body embalmed or dried, in the manner used by the ancient Egyptians; or the composition with which it is embalmed. There are two kinds of bodies denominated *mummies*. The first are only carcases dried by the heat of the sun, and by that means kept from putrefaction: these are frequently found in the sands of Libya. Some imagine, that these are the bodies of deceased people buried there on purpose to keep them entire without embalming; others think they are the carcases of travellers who have been overwhelmed by the clouds of sand raised by the hurricanes frequent in those deserts. The second kind of mummies are bodies taken out of the catacombs near Cairo, in which the Egyptians deposited their dead after embalming. See EMBALMING.

We have two different substances preserved for medicinal use under the name of *mummy*, though both in some degree of the same origin. The one is the dried and preserved flesh of human bodies, embalmed with myrrh and spices; the other is the liquor running from such mummies, when newly prepared, or when affected by great heat or damps. The latter is sometimes in a liquid, sometimes of a solid form, as it is preserved in vials well stopped, or suffered to dry and harden in the air. The first kind of mummy is brought to us in large pieces, of a lax and friable texture, light and spongy, of a blackish brown colour, and often damp and clammy on the surface: it is of a strong but disagreeable smell. The second kind of mummy, in its liquid state, is a thick, opaque, and viscous fluid, of a blackish colour, but not disagreeable smell. In its indurated state, it is a dry solid substance, of a fine shining black colour, and close texture, easily broken, and of a good smell; very inflammable, and yielding a scent of myrrh and aromatic ingredients while burning. This, if we cannot be content without medicines from our own bodies, ought to be the mummy used in the shops; but it is very scarce and dear; while the other is so cheap, that it will always be most in use.

All these kinds of mummies are brought from Egypt. But we are not to imagine, that any body breaks up the real Egyptian mummies, to sell them in

pieces

Mummy || Munda.

pieces to the druggists, as they make a much better market of them in Europe whole, when they can contrive to get them. What our druggists are supplied with, is the flesh of executed criminals, or of any other bodies the Jews can get, who fill them with the common bitumen, so plentiful in that part of the world; and adding a little aloes, and two or three other cheap ingredients, send them to be baked in an oven, till the juices are exhaled, and the embalming matter has penetrated so thoroughly that the flesh will keep and bear transporting into Europe. Mummy has been esteemed resolvent and balsamic: but whatever virtues have been attributed to it, seem to be such as depend more upon the ingredients used in preparing the flesh than in the flesh itself; and it would surely be better to give those ingredients without so shocking an addition.

There are found in Poland a kind of natural mummies, or human bodies preserved without the assistance of art. These lie in considerable numbers in some of the vast caverns in that country. They are dried with the flesh and skin shrunk up almost close to the bones, and are of a blackish colour. In the wars which several ages ago laid waste that country, it was common for parties of the weaker side to retire into these caves, where their enemies, if they found them out, suffocated them by burning straw, &c. at the mouth of the cavern, and then left the bodies; which, being out of the way of injuries from common accidents, have lain there ever since.

MUMMY, among gardeners, a kind of wax used in grafting and planting the roots of trees, made in the following manner: Take one pound of black pitch, and a quarter of a pound of turpentine; put them together into an earthen pot, and set them on fire in the open air, holding something in your hand to cover and quench the mixture in time, which is to be alternately lighted and quenched till all the nitrous and volatile parts be evaporated. To this a little common wax is to be added; and the composition is then to be set by for use.

MUMPS. See MEDICINE *Index*.

MUNDA, an ancient town of Spain, in the kingdom of Granada, seated on the declivity of a hill, at the bottom of which runs a river. W. Long. 4. 13. N. Lat. 48. 15.

This city was anciently famous for a victory gained by Cæsar over the two sons of Pompey, who had collected an army in Spain after the defeat of their father at Pharsalia. See (*History of*) ROME.

The Pompeys posted their army advantageously on a rising ground, whereof one side was defended by the city of Munda, and the other by a small river which watered the plain, and by a marsh: so that the enemy could not attack them but in front. Cæsar likewise drew up his troops with great art, and having advanced a little way from his camp, ordered them to halt, expecting the enemy would abandon their advantageous post, and come to meet him. But as they did not stir, Cæsar made as if he intended to fortify himself in that post; which induced the young general, who looked upon this as a sign of fear, to advance into the plain, and attack the enemy before they could secure themselves with any works. Pompey's army was by far the most numerous: for it consisted of 13 legions, 6000 horse, and an incredible number of auxiliaries, among whom were all the forces of Bocchus king of Mauritania, commanded by his two sons, both youths of great valour and bravery. Cæsar had 80 cohorts, three legions, to wit, the third, the fifth, and the tenth, and a body of 8000 horse. As the enemy drew near, Cæsar betrayed a great deal of uneasiness and concern, as if he were doubtful of the success, knowing he was to engage men no way inferior in valour and experience to his own, and commanded by officers who had on many occasions given signal proofs of their bravery and conduct. Cneius, the elder of the two brothers, was generally looked upon as an able commander; and Labienus, who had revolted, esteemed scarce inferior to himself.

Munda.

However, the dictator, desirous to put an end to the civil war, either by his own death, or that of his rivals, gave the signal for the battle, and fell upon the enemy with his usual vigour and resolution. At the first onset, which was dreadful, the auxiliaries on both sides betook themselves to flight, leaving the Romans to decide their quarrel by themselves. Then the legionaries engaged with a fury hardly to be expressed; Cæsar's men being encouraged by the hopes of putting an end to all their labours by this battle; and those of Pompey exerting themselves out of necessity and despair, since most of them expected no quarter, as having been formerly pardoned. Never was victory more obstinately disputed. Cæsar's men, who had been always used to conquer, found themselves so vigorously charged by the enemy's legionaries, that they began to give ground; and though they did not turn their backs, yet it was manifest that shame alone kept them in their posts. All authors agree, that Cæsar had never been in so great danger; and he himself, when he came back to his camp, told his friends, that he had often fought for victory, but this was the first time he had ever fought for life. Thinking himself abandoned by fortune, which had hitherto favoured him, he had some thoughts of stabbing himself with his own sword, and by a voluntary death preventing the disgrace of a defeat: but returning soon to himself, and concluding it would be more to his reputation to fall by the enemy's hand at the head of his troops, than, in a fit of despair, by his own, he dismounted from his horse, and snatching a buckler from one of his legionaries, he threw himself like a man in despair into the midst of the enemy; crying out to his men, *Are you not ashamed to deliver your general into the hands of boys?* At these words, the soldiers of the tenth legion, animated by the example of their general, fell upon the enemy with fresh vigour, and made a dreadful havock of them. But in spite of their utmost efforts, Pompey's men still kept their ground, and, though greatly fatigued, returned to the charge with equal vigour. Then the Cæsareans began to despair of victory; and the dictator, running through the ranks of his disheartened legionaries, had much ado to keep them together. The battle had already lasted from the rising to the setting of the sun, without any considerable advantage on either side.

At length a mere accident decided the dispute in favour of the dictator. Bogud, a petty king of Mauritania, had joined Cæsar soon after his arrival in Spain, with some squadrons of Numidian horse; but in the very

Munda ‖ Munich.

very beginning of the battle, being terrified at the shouting of the soldiers, intermingled with groans, and the clashing of their arms, he had abandoned his post, and retired with the auxiliaries under his command to a rising ground at a small distance from the enemy's camp. There he continued the whole day an idle spectator of the battle that was fought in the plain. But towards the evening, partly out of shame and partly out of compassion for his friend Cæsar, he resolved to fall upon Pompey's camp; and accordingly flew thither with all the forces he had with him. Labienus, apprised of his design, hastened after him to the defence of the camp; which Cæsar observing, cried to his legionaries, *Courage, fellow soldiers! the victory at length is ours; Labienus flies.* This artifice had the desired effect: Cæsar's men, believing that Labienus was truly fled, made a last effort, and charged the wing he commanded so briskly, that after a most obstinate dispute they put them to flight.

Though the enemy's left wing was thus entirely defeated, the right wing, where the elder Pompey commanded, still kept their ground for some time. Pompey dismounting from his horse, fought on foot like a private man in the first line, till most of his legionaries being killed, he was forced to save himself by flight from falling into the enemy's hands. Part of his troops fled back to their camp, and part took shelter in the city of Munda. The camp was immediately attacked, and taken sword in hand; and as for the city, Cæsar, without loss of time, drew a line of circumvallation round it. This victory was gained on the 16th of the kalends of April, i. e. according to our way of counting, on the 17th day of March, when the Dionysian festival, or the Liberalia, were celebrated at Rome; the very day, as Plutarch observes, in which Pompey the Great, four years before, had set out for the war. In this action Pompey lost 30,000 men; among whom were the famous Labienus, Attius Varus, and 3000 Roman knights. Seventeen officers of distinction were taken, and all the enemy's eagles and ensigns, together with Pompey's fasces, which he had assumed as governor of Spain. On Cæsar's side, only 1000 men were killed and 500 wounded.

MUNDIC, or MARCASITE, an old name for pyrites of copper or iron. See *Ores of Copper and Iron*, MINERALOGY *Index*.

MUNDINGOES, the name of a people who live on the sides of the river Gambia in Africa, and who are of a jet black colour, strong, and well made. They have a priest sent over every year from one of the Cape de Verd islands to christen and marry.

MUNDUS PATENS, the open world, in Roman antiquity, a solemnity performed in a small temple, of a round form like the world, dedicated to *Dis* and the rest of the infernal gods. This temple was opened but three times in the year, viz. the 24th of August, the 4th of October, and the 7th of November. During these days, the Romans believed hell was open; on these days therefore they never offered battle, listed soldiers, put to sea, or married.

MUNICH, a town of Germany, capital of the duchy, now the kingdom, of Bavaria. It stands on the Iser, 70 miles south of Ratisbon and 214 west of Vienna, being one of the most pleasant and populous cities of Germany for its bigness. The number of the inhabitants in 1781 was 48,000. Having been built at first on a spot of ground belonging to a convent, it had from thence in German the name of *Munchen*, i. e. *Monk's town*, and a monk for its arms. The elector's palace here is a very grand structure, consisting of several courts, furnished and adorned in the most magnificent manner, with tapestry, gilding, sculpture, statues, and paintings. It contains an amazing collection of jewels, antiquities, and curiosities. The great hall is 118 feet long and 52 broad; and the staircase leading to it, from top to bottom of marble and gold. In the hall of antiquities are 354 busts and statues of jasper and porphyry, brass and marble. In this palace is a library, containing a vast collection of books, and many valuable manuscripts, in most languages ancient and modern; and a chamber of rarities, among which is the picture of a bravo or assassin, who is said to have committed 345 murders with his own hand, and to have been accomplice in, or privy to, 400 more. The treasury in the chapel contains also a vast number of pictures, precious stones, medals, vessels of gold and silver, &c. Among other curiosities, here is a cherry stone with 140 heads distinctly engraved upon it. The gardens of the palace are also very fine, and it is said a secret passage leads from it to all the churches and convents in the town. There is a great number of other fine buildings in this city, public and private, particularly the riding house, town house, opera room, the Jesuits college, the large edifice for tournaments, the churches, convents, fountains, &c. Its manufactures are those of silk, particularly velvet, woollen cloths, and tapestry; and it has two annual fairs, at which great quantities of salt, wine, &c. are sold. The streets are broad and regular; and most of the houses well built, and painted on the outside. The market place is extremely beautiful. Not far from Munich are four other palaces, with fine gardens, belonging to the elector, viz. those of Sleisheim, Nymphenburg, Dauchau, and Starenberg. The first and last are about three leagues from the capital; the second about half a league; and the third about two leagues. It was unsuccessfully attacked by the French in 1796. See BAVARIA, SUPPLEMENT.

Munich, Municipal

MUNICH, *Count de*, was the favourite of the czarina Ann, and was concerned in all the events of her reign. Being appointed general of her armies, he gained great advantages over the Crim Tartars, beat the Turks, A. D. 1739, in an engagement near Choczim, and took that city together with Jassi the capital of Moldavia. He was afterwards prime minister to the czar Iwan VI. but in a short time after he was accused of employing the power which his office conferred on him to gratify his own ambition and private resentment. The empress Elizabeth brought him to trial, and he was condemned to lose his life, A. D. 1742. This sentence was mitigated to banishment into Siberia, whither many of the victims of his power had been exiled. He was recalled by Peter III. A. D. 1762, and declared field marshal. Upon the death of this prince, the empress Catharine II. appointed him director general of the ports of the Baltic. He died on the 8th of October 1767, at the age of 84.

MUNICIPAL, in the Roman civil law, an epithet which signifies invested with the rights and privileges of Roman citizens. See MUNICIPIUM.

MUNICIPAL,

Municipal || Munster.

MUNICIPAL, among us, is applied to the laws that obtain in any particular city or province. And those are called *municipal officers* who are elected to defend the interests of cities, to maintain their rights and privileges, and to preserve order and harmony among the citizens; such as mayors, sheriffs, consuls, &c.

MUNICIPES, an appellation given by the Romans to the inhabitants of the *municipia* or municipal cities. See MUNICIPIUM.

MUNICIPIUM, in Roman antiquity, a corporation borough, or enfranchised city or town, where the inhabitants enjoyed their own laws and customs, and at the same time were honoured with the privileges of Roman citizens; but then this privilege generally reached no further than the bare title. Some indeed, by particular merit, obtained the liberty of votes, which occasioned that distinction of *municipium sine suffragio*, and *municipium cum suffragio*.—The inhabitants of the *municipium sine suffragio* were called barely *Romani*, but those of the *municipium cum suffragio* were called *cives Romani*.

The difference between proper citizens of Rome and the inhabitants of the municipium may be thus expressed. The proper citizens of Rome were, 1. Registered in the census; 2. Had the right of suffrage and of bearing honours; 3. Were assessed in the poll-tax; 4. Served in the legions; 5. Used the Roman laws and religion; 6. Were called *Quirites* and *populus Romanus*: Whereas the municipes enjoyed the three first of these privileges, but were denied the three last.

MUNITION, the provisions with which a place is furnished in order for defence; or that which follows a camp for its subsistence.

MUNITION Ships, are those that have stores on board in order to supply a fleet of men of war at sea. In an engagement, all the munition ships and victuallers attending the fleet take their station in the rear of all the rest; they are not to engage in the fight, but to attend to such directions as are sent to them by the admiral.

MUNSTER, in Latin *Monomia*, and in Irish *Moun*, the most southerly province of Ireland; bounded on the north by Leinster and Connaught, and on the east, west, and south, by the ocean. It contains the counties of Cork, Clare, Kerry, Limerick, Tipperary, and Waterford; and 3,289,932 Irish plantation acres, 740 parishes, 63 baronies, and 26 boroughs. It is about 125 miles long and 120 broad; and its principal town is Cork. Its ancient name was *Mumhan*; and in latter ages it was divided into *Desmond* or South Munster, *Ormond* or East Munster, and *Thomond* or North Munster. It lies between 51. 15. and 53. 0. N. Lat. and 7. 10. and 10. 40. W. Long.

MUNSTER, a bishopric of Germany in the circle of Westphalia, and territories of Prussia; bounded on the north by Embden and Oldenburg, on the south by the county of Mark and duchy of Westphalia, on the west by the county of Bentheim and the United Provinces, and on the east by the bishopries of Osnaburgh and Paderborn together with the county of Ravensberg. It is the largest of all the Westphalian bishopries, being in length about 80 miles, and in breadth from 20 to 60, and contains 350,000 inhabitants. It is divided into 13 bailiwicks: and though in general but a barren country, has some fruitful plains, with woods, and quarries of stone. The inhabitants, excepting a few of the nobility and gentry, are all Roman Catholics; though Lutheranism had once a considerable footing here. The bishop, who was generally also elector of Cologne, has a revenue of about 70,000 pounds, and can maintain 8000 men. By an unjust custom, unknown in the rest of the empire, he is heir to all strangers who die in the country without children. In the matricula he is rated at 30 foot and 118 horse; or 832 florins monthly in lieu of them. His chapter consists of 40 canons, who are all noble.

Munster || Muræna.

MUNSTER, a city of Germany, capital of a bishopric of the same name, and of all Westphalia, stands at the conflux of the river Aa with the Ems, in E. Long. 7. 49. N. Lat. 52. 0. It is of a circular form, large, and had strong fortifications which have been thrown down. The citadel, called the *Brille*, has been converted into a residence for the bishop. The dean and chapter now elect the bishop; but till the beginning of the 13th century he was nominated by the emperor. This city has been rendered famous by three remarkable transactions. 1. By the peace concluded here in 1648, which put an end to the war of 30 years; occasioned by the persecuting spirit of bigotted Papists, who chose rather to plunge their country into all the calamities of war than allow liberty of conscience to the Protestants. By this peace, however, they consented, much against their inclinations, to grant them a toleration. 2. By the disorders and disturbances occasioned here in 1553, by a parcel of enthusiasts, headed by a taylor, called *John of Leyden* from the place of his birth, who turned out the magistrates, and took possession of the city, where they perpetrated the most horrid villanies and cruelties. 3. For the noble, though unsuccessful, efforts it made in defence of its liberties against the tyranny and oppression of the above mentioned turbulent and bloody-minded bishop, Bernard van Galen. In this city are a great number of convents and other religious houses, many of them stately piles, and surrounded with beautiful gardens.

MUNYCHIA, or *Munichius Portus*, in *Ancient Geography*, a village and port of Athens, nearer to the city, fortified in the same manner as the Piræus, to the east of which it lay, or between it and the promontory Sunium, at the mouth of the Ilissus. Strabo says it was an eminence in form of a peninsula, at the foot of which stood three harbours, anciently encompassed with a wall, taking within its extent the Piræus and other harbours full of docks, with the temple of Diana Munychia; taking its name from *Munichus*, the founder of the temple.

MUNYCHIA, an anniversary solemnity observed at Athens, in honour of Diana, on the 16th of the month Munychion. Cakes were offered on the occasion, called αμφιφωντες.

MUNYCHION, the tenth month of the Athenian year, containing 29 days, and answering to the latter part of our March and the beginning of April. It was so called from the festival Munychia, which was observed in this month. See MONTH and MUNYCHIA.

MUPHTI. See MUFTI.

MURÆNA, or EEL; a genus of fishes, belonging to the order of apodes. See ICHTHYOLOGY *Index*,

MURAL.

Mural || Murcia.

MURAL, something belonging to a wall, which the Latins call *murus*.

Mural Crown, among the ancient Romans. See Crown.

Mural Arch, is a wall, or walled arch, placed exactly in the plane of the meridian, i. e. upon the meridian line, for the fixing of a large quadrant, sextant, or other instrument, to observe the meridian altitudes, &c. of the heavenly bodies.

Tycho Brahe was the first who used a mural arch in his observations; after him Hevelius, Mr Flamstead, De la Hire, &c. used the same means. See Astronomy.

MURANUM, in *Ancient Geography*, a town of the confines of Lucania. Now *Morano;* a citadel in Calabria Citra, at the springs of the Sybaris, midway between the Sinus Tarentinus to the east, and the Tuscan sea to the west. Supposed to have risen from the ruins of Syphæum, a town of the Bruttii mentioned by Livy.

MURATORI, Lewis, Anthony, a learned and celebrated Italian writer, born at Vignoles, in the territory of Bologna, in 1672. He early discovered an extreme fondness for the learned languages and sciences; and this was seconded by an excellent education. After having completed his first studies, he embraced the state of an ecclesiastic; and applied himself to polite literature, philosophy, theology, civil law, antiquities, and other sciences; by which means he became in a manner universally learned. He was scarcely 22 years of age when he was made librarian of the Ambrosian library at Milan. In 1700 the duke of Modena, his sovereign, recalled him, and made him his librarian, and keeper of the archives of his duchy. Muratori discharged this double employment during the rest of his life, and had no other benefice than the provostship of Santa Maria del Pomposa. The principal of his works are,—1. *Anecdota*, or a collection of pieces taken from the Ambrosian library, 2 vols 4to, with learned notes and dissertations. 2. A treatise on the perfection of the Italian poetry, 2 vols 4to. 3. *Anecdota Græca*, 3 vols 4to. 4. A genealogical history of the house of Modena, 2 vols folio. 5. An excellent collection of the writers of the Italian history, 27 vols folio, with learned notes. 6. Another collection, under the title of *Antiquitates Italicæ*. 7. A collection of ancient inscriptions, under the title of *Novus Thesaurus*, 6 vols folio. 8. The annals of Italy, 12 vols 4to, in Italian, &c. 9. Letters, dissertations, Italian poems, &c.

MURCIA, the Pagan goddess of idleness. The name is taken from *murcus* or *murcidus*, an obsolete word, signifying a dull, slothful, or lazy person.—The statues of this goddess were always covered with dust and moss, to express her idleness and negligence. She had a temple at Rome, at the foot of the Aventine mount.

Murcia, a kingdom in Spain, bounded on the north by New Castile, on the east by the kingdom of Valencia, on the west by Andalusia and Granada, and on the south by the Mediterranean sea. It is about 62 miles in length, and 58 in breadth; and its principal river is the Segura. The soil is dry, because it seldom rains, and therefore it produces little corn or wine; but there is plenty of oranges, citrons, lemons, olives, almonds, mulberries, rice, pulse, and sugar. It has also a great deal of silk. It was taken from the Moors in 1265. The air is very healthful. Murcia, Murder.

Murcia, a large, handsome, and populous town of Spain, capital of a kingdom of the same name. It is a bishop's see, and contains six parishes. The cathedral is a most superb edifice, with the stairs of the steeple so contrived that a man may ride up to the top, either on horseback or in a coach. It is situated in a pleasant plain, which abounds in fine gardens about the city, and in which are the best fruits in Spain. It is seated on the river Segura, in W. Long. 8. 36. N. Lat. 37. 48.

MURDER, or Murther, the act of killing another with violence and injustice. The word comes from the Saxon *morth*, "death;" which some will have to signify a violent death; whence the barbarous Latin *murdrum* and *modrum*.

Among the number of popular errors, is the notion which has obtained, that the dead body would bleed in the presence or upon the touch of the murderer.

The crime of murder is punished with death in almost all nations.

Murder, or *Murther*, in *Law*, is thus defined, or rather described, by Sir Edward Coke: "When a person, of sound memory and discretion, unlawfully killeth any reasonable creature in being, and under the king's peace, with malice aforethought, either express or implied." The best way of examining the nature of this crime will be by considering the several branches of this definition.

1. It must be committed by a person *of sound memory and discretion:* for lunatics or infants are incapable of committing any crime; unless in such cases where they show a consciousness of doing wrong, and of course a discretion or discernment between good and evil.

2. Next, it happens when a person of such sound discretion *unlawfully killeth*. The unlawfulness arises from the killing without warrant or excuse: and there must also be an actual killing to constitute murder; for a bare assault, with intent to kill, is only a great misdemeanour, though formerly it was held to be murder. The killing may be by poisoning, striking, starving, drowning, and a thousand other forms of death, by which human nature may be overcome. Of these the most detestable of all is poison; because it can of all others be the least prevented, either by manhood or forethought. And therefore, by the stat. 22 Hen. VIII. c. 9. it was made treason, and a more grievous and lingering kind of death was inflicted on it than the common law allowed; namely, *boiling to death:* but this act did not live long, being repealed by 1 Edw. VI. c. 12. There was also, by the ancient common law, one species of killing held to be murder, which may be dubious at this day, as there hath not been an instance wherein it has been held to be murder for many ages past, viz. bearing false witness against another, with an express premeditated design to take away his life, so as the innocent person be condemned and executed. The Gothic laws punished in this case both the judge, the witnesses, and the prosecutor; and, among the Romans, the *lex Cornelia de sicariis*, punished the false witnesses with death, as being guilty of a species of assassination. And there is no doubt but this is equally murder *in foro conscientiæ*

Murder. *conscientiæ* as killing with a sword; though the modern law (to avoid the danger of deterring witnesses from giving evidence upon capital prosecutions, if it must be at the peril of their own lives) has not yet punished it as such. If a man, however, do such an act, of which the probable consequence may be, and eventually is, death; such killing may be murder, although no stroke be struck by himself, and no killing may be primarily intended: as was the case of the unnatural son who exposed his sick father to the air against his will, by reason whereof he died; and of the harlot, who laid her child under leaves in an orchard, where a kite struck and killed it. So too, if a man have a beast that is used to do mischief; and he, knowing it, *suffers* it to go abroad, and it kills a man; even this is manslaughter in the owner; but if he have purposely *turned it loose*, though barely to frighten people, and make what is called *sport*, it is with us (as in the Jewish law) as much murder as if he had incited a bear or dog to worry them. If a physician or surgeon give his patient a potion or plaster to cure him, which, contrary to expectation, kills him, this is neither murder nor manslaughter, but misadventure; and he shall not be punished criminally, however liable he might formerly have been to a civil action for neglect or ignorance; but it hath been holden, that if it be not a *regular* physician or surgeon who administers the medicine, or performs the operation, it is manslaughter at the least. Yet Sir Matthew Hale very justly questions the law of this determination; since physic and salves were in use before licensed physicians and surgeons: wherefore he treats this doctrine as apocryphal, and fitted only to gratify and flatter licenciates and doctors in physic; though it may be of use to make people cautious and wary how they meddle too much in so dangerous an employment. In order also to make the killing murder, it is requisite that the party die within a year and a day after the stroke received, or cause of death administered; in the computation of which the whole day upon which the hurt was done shall be reckoned the first.

3. Farther: The person killed must be "a *reasonable creature in being, and under the king's peace*," at the time of the killing. Therefore to kill an alien, a Jew, or an outlaw, who are all under the king's peace or protection, is as much murder as to kill the most regular-born Englishman; except he be an alien-enemy, in the time of war. To kill a child in its mother's womb, is now no murder, but a great misprision; but if the child be born alive, and dieth by reason of the potion or bruises it received in the womb, it seems, by the better opinion, to be murder in such as administered or gave them. As to the murder of bastard children, see BASTARD.

4. Lastly, The killing must be committed "*with malice aforethought*," to make it the crime of murder. This is the grand criterion, which now distinguishes murder from other killing: and this malice prepense, *malitia præcogitata*, is not so properly spite or malevolence to the deceased in particular, as any evil design in general; the dictate of a wicked, depraved, and malignant heart; *un disposition à faire une mal chose*: and it may be either *express*, or *implied*, in law. Express malice is when one, with a sedate deliberate mind and formed design, doth kill another, which formed design is evidenced by external circumstances discovering that inward intention; as lying in wait, antecedent menaces, former grudges, and concerted schemes to do him some bodily harm. This takes in the case of deliberate duelling, where both parties meet avowedly with an intent to murder: thinking it their duty, as gentlemen, and claiming it as their right, to wanton with their own lives and those of their fellow creatures; without any warrant or authority from any power either divine or human, but in direct contradiction to the laws of both God and man; and therefore the law has justly fixed the crime and punishment of murder on them, and on their seconds also. Yet it requires such a degree of passive valour to combat the dread of even undeserved contempt, arising from the false notions of honour too generally received in Europe, that the strongest prohibitions and penalties of the law will never be entirely effectual to eradicate this unhappy custom, till a method be found out of compelling the original aggressor to make some other satisfaction to the affronted party, which the world shall esteem equally reputable as that which is now given at the hazard of the life and fortune, as well of the person insulted, as of him who has given the insult. Also, if even upon a sudden provocation one beats another, in a cruel and unusual manner, so that he dies, though he did not intend his death, yet he is guilty of murder by express malice; i. e. by an express evil design, the genuine sense of *malitia*: As when a park-keeper tied a boy that was stealing wood to a horse's tail, and dragged him along the park: when a master corrected his servant with an iron bar, and a schoolmaster stamped on his scholar's belly, so that each of the sufferers died; these were justly held to be murders, because the correction being excessive, and such as could not proceed but from a bad heart, it was equivalent to a deliberate act of slaughter. Neither shall he be guilty of a less crime who kills another in consequence of such a wilful act as shows him to be an enemy to all mankind in general; as going deliberately, and with an intent to do mischief, upon a horse used to strike, or coolly discharging a gun among a multitude of people. So if a man resolves to kill the next man he meets, and does kill him, it is murder, although he knew him not; for this is universal malice. And if two or more come together to do an unlawful act against the king's peace, of which the probable consequence might be bloodshed; as to beat a man, to commit a riot, or to rob a park, and one of them kills a man; it is murder in them all, because of the unlawful act, the *malitia præcogitata*, or evil intended beforehand.

Murder.

Also in many cases where no malice is expressed, the law will imply it: as, where a man wilfully poisons another, in such a deliberate act the law presumes malice, though no particular enmity can be proved. And if a man kills another suddenly, without any, or without a considerable provocation, the law implies malice; for no person, unless of an abandoned heart, would be guilty of such an act upon a slight or no apparent cause. No affront, by words or gestures only, is a sufficient provocation, so as excuse or extenuate such acts of violence as manifestly endanger the life of another. But if the person so provoked had unfortunately killed the other, by beating him in such a manner as showed only

Murder. only an intent to chastise and not to kill him, the law so far considers the provocation of contumelious behaviour, as to adjudge it only manslaughter, and not murder. In like manner, if one kills an officer of justice, either civil or criminal, in the execution of his duty, or any of his assistants endeavouring to conserve the peace, or any private person endeavouring to suppress an affray or apprehend a felon, knowing his authority or the intention with which he interposes, the law will imply malice, and the killer shall be guilty of murder. And if one intends to do another felony, and undesignedly kills a man, this is also murder. Thus if one shoots at A, and misses him, but kills B, this is murder; because of the previous felonious intent, which the law transfers from one to the other. The same is the case, where one lays poison for A, and B, against whom the prisoner had no malicious intent, takes it, and it kills him, this is likewise murder. So also, if one give a woman with child a medicine to procure abortion, and it operates so violently as to kill the woman, this is murder in the person who gave it. It were endless to go through all the cases of homicide, which have been adjudged, either expressly or impliedly, malicious: these therefore may suffice as a specimen; and we may take it for a general rule, that all homicide is malicious, and of course amounts to murder, unless where justified by the command or permission of the law; excused on a principle of accident or self-preservation; or alleviated into manslaughter, by being either the involuntary consequence of some act, not strictly lawful, or (if voluntary) occasioned by some sudden and sufficiently violent provocation. And all these circumstances of justification, excuse, or alleviation, it is incumbent upon the prisoner to make out, to the satisfaction of the court and jury, the latter of whom are to decide whether the circumstances alleged are proved to have actually existed; the former, how far they extend to take away or mitigate the guilt. For all homicide is presumed to be malicious, until the contrary appeareth upon evidence.

The punishment of murder, and that of man-slaughter, were formerly one and the same; both having the benefit of clergy; so that none but unlearned persons, who least knew the guilt of it, were put to death for this enormous crime. But now, by several statutes, the benefit of clergy is taken away from murderers through malice prepense, their abettors, procurers, and counsellors. In atrocious cases it was frequently usual for the court to direct the murderer, after execution, to be hung upon a gibbet in chains near the place where the fact was committed; but this was no part of the legal judgment; and the like is still sometimes practised in the case of notorious thieves. This, being quite contrary to the express command of the Mosaical law, seems to have been borrowed from the civil law; which, besides the terror of the example, gives also another reason for this practice, viz. that it is a comfortable sight to the relations and friends of the deceased. But now, in England, it is enacted by statute 25 Geo. II. c. 37. that the judges, before whom any person is found guilty of wilful murder, shall pronounce sentence immediately after conviction, unless he sees cause to postpone it; and shall in passing sentence direct him to be executed on the next day but one (unless the same shall be Sunday, and then on the Monday following), and that his body be delivered to the surgeons to be dissected and anatomized; and that the judge may direct his body to be afterwards hung in chains, but in nowise to be buried without dissection. And, during the short but awful interval between sentence and execution, the prisoner shall be kept alone, and sustained with only bread and water. But a power is allowed to the judge, upon good and sufficient cause, to respite the execution, and relax the other restraints of this act. See farther, PARRICIDE, and *Petit Treason*.

Murder || Murrhine

MURDERERS, or *Murdering Pieces*, in a ship, are small pieces of ordnance, either of brass or iron, which have chambers put in at their breeches. They are used at the bulk-heads of the fore-castle, half-deck, or steerage, in order to clear the deck, on the ship's being boarded by an enemy.

MURENA. See MURÆNA, ICHTHYOLOGY. *Index*.

MURENGERS, two officers of great antiquity in the city of Chester, annually chosen out of the aldermen, to see the walls kept in repair, and to receive a certain toll for that purpose.

MUREX, a genus of animals belonging to the order of vermes testacea. See CONCHOLOGY *Index*.

MUREX, a caltrap or iron instrument, with sharp points projecting in every direction, used by the Romans as a defence against the enemy's horse; so called, probably from some resemblance to the spines on the shell of the murex.

MURGI, or MURGIS, in *Ancient Geography*, the last town of Bætica, next the Tarraconensis; the Urce of Ptolemy. Now *Muxara*, a port-town of Granada, on the Mediterranean. W. Long. 1° 50′. N. Lat. 37° 6′.

MURIA, the Latin name of common salt. See SODA, *Muriate of*, CHEMISTRY *Index*.

MURIATIC ACID. See CHEMISTRY *Index*. This acid, according to the views of Sir H. Davy, is composed of chlorine (the oxymuriatic acid of all chemists formerly, and of some still) and hydrogen.

MURINA, or MURINES, a delicious sweet wine, medicated with spices, and the usual drink of the ladies of antiquity.

MURRAIN, or GARGLE, a contagious disease among cattle. See FARRIERY. *Index*.

MURRAY, or MORAY, the name of a district in the north of Scotland, which, in a former division of the kingdom, was denominated a province. This district includes the counties of Banff, Elgin and Nairn. The county of Elgin, the middle division of this district, is still known by the name of Morayshire.

MURRHINE, MURRHINUS, Μορρινος, in antiquity, an appellation given to a delicate sort of ware brought from the east, whereof cups and vases were made, which added not a little to the splendour of the Roman banquets. Critics are divided concerning the matter of the pocula or vasa murrhina, murrina, or murrea. Some will have them to have been the same with our porcelain or china ware. The generality held them to have been made of some precious kind of stone, which was found chiefly, as Pliny tells us, in Parthia, but more especially in Carmania. Arrian tells us, that there was a great quantity of them made at Diospolis in Egypt. This he calls another sort of murrhina work; and it is evident, from all accounts, that the murrhina of Diospolis was a sort of

Murrhine || Musæus.

of glass ware, made in imitation of the porcelain or murrha of India. There is some difference in the accounts given by Pliny and Martial of the murrhina vasa. The first author says, that they would not bear hot liquors, but that only cold ones were drank out of them. The latter, on the other hand, tells us, that they bore hot liquors very well. If we credit Pliny's account, their porcelain was much inferior to our's in this particular. Some conjecture them to have been of agate, others onyx, others of coral. Baronius, doubtless, was farthest out of the way, when he took them to be made of myrrh, congealed and hardened. Some have supposed these vessels to be made of crystal, but this is contrary to the account of all the ancients. The Greeks had the words κρυσταλλος, for crystal, and σμυρνη for myrrh, very common among them; and therefore if these vessels had been made of either of these substances, they would in some places have called them smyrna or crystalline. On the contrary, the most correct among them call them murrhina or morrina. The cups made of crystal, which were also in use at those times were called crystallina, and these murrhina or murrhæa, by way of keeping up the distinction; and Martial tells us that the stone they were made of was spotted or variegated, calling them pocula maculosæ murræ. And Statius mentions the crystalline and murrhine cups in the same sentence, but as different things, not the same. Arrian mentions also the λιθος μοζζια; which his interpretors censure as an error of the copies, and would alter into myrrha, the name of the gum myrrh.

Pompey is recorded as the first who brought these murrhine vessels out of the east, which he exhibited in his triumph, and dedicated to Jupiter Capitolinus. But private persons were not long without them. So fond in effect did the Roman gentry grow of them, that a cup which held three sextaries was sold for 70 talents. T. Petronius, before his death, to spite Nero (or as Pliny expresses it, *ut mensam ejus exhæredaret*, to disinherit his table), broke a hason, *trulla murrhina*, valued at 300 talents, on which that emperor had set his heart.

MUS, a genus of quadrupeds belonging to the order of *Glires*. See MAMMALIA *Index*.

MUSA, the PLANTAIN-TREE; a genus of plants belonging to the polyandria class, and in the natural method ranking under the eighth order, *Scitamineæ*. See BOTANY *Index*.

MUSÆUS, an ancient Greek poet, was, according to Plato and Diodorus Siculus, an Athenian, the son of Orpheus, and chief of the Eleusinian mysteries instituted at Athens in honour of Ceres: or, according to others, he was only the disciple of Orpheus; but from the great resemblance which there was between his character and talents and those of his master, by giving a stronger outline to the figure he was called his *son*, as those were styled the *children of Apollo* who cultivated the arts of which he was the tutelar god.

Musæus is allowed to have been one of the first poets who versified the oracles. He is placed in the Arundelian marbles, epoch 15. 1426 B. C. at which time his hymns are there said to have been received in the celebration of the Eleusinian mysteries. Laertius tells us, that Musæus not only composed a theogony, but formed a sphere for the use of his companions; yet as this honour is generally given to Chiron, it is more natural to suppose, with Sir Isaac Newton, that he enlarged it with the addition of several constellations after the conquest of the golden fleece. The sphere itself shows that it was delineated after the Argonautic expedition, which is described in the asterisms, together with several other more ancient histories of the Greeks, and without any thing later; for the ship Argo was the first long vessel which they had built: hitherto they had used round ships of burden, and kept within sight of the shore; but now, by the dictates of the oracle, and consent of the princes of Greece, the flower of that country sail rapidly through the deep, and guide their ship by the stars.

Musæus || Muschenbroeck. *Burney's History of Music.*

Musæus is celebrated by Virgil in the character of hierophant, or priest of Ceres, at the head of the most illustrious mortals who have merited a place in Elysium. Here he is made the conductor of Æneas to the recess where he meets the shade of his father Anchises.

A hill near the citadel of Athens was called *Musæum*, according to Pausanias, from Musæus, who used to retire thither to meditate and compose his religious hymns; at which place he was afterwards buried. The works which went under his name, like those of Orpheus, were by many attributed to Onomacritus. Nothing remains of this poet now, nor were any of his writings extant in the time of Pausanias, except a hymn to Ceres, which he made for the Lycomides. And as these hymns were likewise set to music, and sung in the mysteries by Musæus himself in the character of priest, he thence perhaps acquired from future times the title of *musician*, as well as of *poet*; the performance of sacred music being probably at first confined to the priesthood in these celebrations, as it had been before in Egypt, whence they originated. However, he is not enumerated among ancient musicians by Plutarch; nor does it appear that he merited the title of *son* and *successor to Orpheus* for his musical abilities, so much as for his poetry, piety, and profound knowledge in religious mysteries.

MUSCA, the FLY; a genus of insects belonging to the order of diptera. See ENTOMOLOGY *Index*.

MUSCA, a name given to such persons among the Romans as officiously thrust themselves into the company of their superiors and those who despised them, by finding means of getting admittance to entertainments without invitation, and without a welcome: So that *muscæ* were the same as parasites, who were frequently by the Greeks termed Μυιαι. See PARASITE.

MUSCADINE, a rich wine, of the growth of Provence, Languedoc, Cividad, &c.—The word is supposed to be derived from *musk*; the wine being supposed to have a little of the smell of that perfume; others from *musca*, "a fly," because the flies are extremely fond of its grapes; as the Latins had their *vinum apianum*, so called *ab apibus*, from the bees which fed on it.

The process for making muscadine at Frontignac, is the following: The muscadine grapes are allowed to be half dried on the vine: and as soon as they are gathered, they are trode and pressed, and the liquor is tunned, without letting it stand to ferment in the fat; the lee which remains is supposed to produce the peculiar flavour of this wine.

MUSCHENBROECK, PETER DE, a very distinguished natural philosopher and mathematician, was

Muschenbroeck || Muses.

born at Utrecht a little before 1700. He was first professor in his own university, and afterwards invited to the chair at Leyden, where he died full of reputation and honours in 1761. He was a member of several academies; particularly the Academy of Sciences at Paris. He was the author of several works in Latin, which are frequently referred to, and all of which discover great penetration and exactness of the subjects of which he treats. He was also consummate in the knowledge of law.

MUSCI, Mosses, one of the orders of the class cryptogamia; which see, Botany *Index*.—The ancients took the moss of trees to be the effect of a disorder or discomposure of the texture of the bark; or at most a kind of little filaments arising from the bark: but the moderns find, by more accurate observation, that mosses are real distinct plants, whose seed, being extremely small, is enclosed in little capsules; which bursting of themselves, the seed is carried off by the winds; till, falling into the inequalities of the bark of trees, it is there stopped, takes root, and feeds at the expence of the tree, as mouldiness does on bread, &c.

MUSCLE, or Mussel. See Mytulus, Conchology *Index*.

MUSCOVY. See Russia.

Muscovy Glass, or Glimmer, See Mica, Mineralogy *Index*.

MUSCULUS, a military machine, made use of by the Romans to cover and protect the soldiers while they approached and undermined the walls of besieged places, or filled the ditches. It seems to have resembled the testudo in form, but was smaller in size. See Testudo.

MUSEIA, were Grecian festivals in honour of the Muses, celebrated with games every fifth year, particularly by the Thespians. The Macedonians also observed a festival of the same name in honour of Jupiter and the Muses, which lasted for nine days, and was celebrated with stage plays, songs, and poetical compositions.

MUSES, certain fabulous deities among the Pagans, supposed to preside over the arts and sciences: for this reason it is usual for the poets, at the beginning of a poem, to invoke these goddesses to their aid.

The Muses were originally only singers and musicians in the service of Osiris, or the great Egyptian Bacchus, under the instruction and guidance of his son Orus; but in succeeding times they were called the *daughters of Jupiter and Mnemosyne* or *Memory*.

These are the only pagan divinities whose worship has been continued through all succeeding changes in the religion and sentiments of mankind. Professors of every liberal art in all the countries of Europe still revere them; particularly the poets, who seldom undertake the slightest work without invoking their aid.

Sir Isaac Newton tells us, that the singing women of Osiris were celebrated in Thrace by the name of the *Muses*; and that the daughters of Pierius, a Thracian, imitating them, were celebrated by the same name. Muses.

Diodorus Siculus informs us, that Alcman of Messene, a lyric poet who flourished in the 27th Olympiad, 670 years B. C. makes them the daughters of Uranus and Terra. It has been asserted by some ancient writers, that at first they were only three in number: but Homer, Hesiod, and other profound mythologists, admit of nine (A).

In his hymn to Apollo, Homer says,

——By turns the *nine* delight to sing.

And Hesiod, in his Theogony, names them all.—They are said severally to preside over some art or science, as music, poetry, dancing, astronomy. By some they are called *virgins*, because the virtues of education appear unalterable: they are called *muses* from a Greek word which signifies to explain mysteries, because they have taught things the most curious and important to know, and which are above the comprehension of vulgar minds. Each of their names is said to include some particular allegory; *Clio*, for instance, has been thus called, because those who are praised in verse acquire immortal fame; *Euterpe*, on account of the pleasure accruing to those who hear learned poetry; *Thalia*, implies for ever flourishing; *Melpomene*, that her melody insinuates itself into the inmost recesses of the soul; *Terpsichore* marks the pleasure which those receive who are versed in the liberal arts; *Erato* seems to indicate, that the learned command the esteem and friendship of all mankind; *Polyhymnia*, that many poets are become immortal by the number of hymns which they have addressed to the gods; *Urania*, that those whom she instructs elevate their contemplations and celebrity to the heavens and the stars; and lastly, the exquisite voice of *Calliope* has acquired her that appellation, as the inventress and guardian of eloquence and rhetoric. *Burney's Hist. of Music.*

An epigram of Callimachus gives the attributes of the Muses in as many lines.

Calliope the deeds of heroes sings;
Great *Clio* sweeps to history the strings;
Euterpe teaches mimes their silent show;
Melpomene presides o'er scenes of wo;
Terpsichore the flute's soft pow'r displays;
And *Erato* gives hymns the gods to praise;
Polymnia's skill inspires melodious strains;
Urania wise, the starry course explains;
And gay *Thalia's* glass points out where folly reigns.

This epigram does not, however, exactly correspond with the ideas of other poets, or of the ancient painters, in characterizing the attributes of the Muses. The ancients had numberless ingenious and fanciful ideas concerning the muses, which we have not room to recite. —"It seems (says the abbé Barthelemi †) as if the first poets, enchanted with the beauties of nature, occasionally were led to invoke the nymphs of the woods, hills, and fountains; and that yielding to the prevailing taste for allegory, they gave them names relative to the influence

† *Travels of Anacharsis*, vol. iii. p. 261.

(A) It has been said, that when the citizens of Sicyon directed three skilful statuaries to make each of them statues of the three Muses, they were all so well executed, that they did not know which to choose, but erected all the nine, and that Hesiod and Homer only gave them names.

Muses, Museum

fluence they might be supposed to have over the productions of the mind. At first three Muses only were admitted, Melete, Mneme, and Aœde: that is to say, the meditation or reflection necessary to study; memory, which records illustrious deeds; and song, which accompanies their recital. In proportion as improvement was made in the art of versification, its characters and effects were personified, the number of the Muses increased, and the names they now received referred to the charms of poetry, its celestial origin, the beauty of its language, the pleasure and gaiety it inspires, the song and dance which add to it new charms, and the glory with which it is crowned. Afterwards were associated with them the Graces, whose employment it is to embellish poetry, and Love who is so frequently its object. These ideas took birth in a barbarous country, in Thrace, where Orpheus, Linus, and their disciples, suddenly appeared in the midst of ignorance. The Muses were honoured there on the Pierian mount; and, extending their dominion, successively took their stations on Pindus, Parnassus, Helicon, and all those solitary places where the painters of nature, surrounded by the most pleasing images, experience the divine glow of inspiration."

Pythagoras, and afterwards Plato, make the Muses the soul of the planets in our system; from whence the imaginary music of the spheres.

MUSEUM, a name which originally signified a part of the palace of Alexandria, which took up at least one-fourth of the city. This quarter was called the *museum*, on account of its being set apart for the Muses and the study of the sciences. Here were lodged and entertained the men of learning; who were divided into many companies or colleges, according to the sciences of which they were the professors; and to each of these houses or colleges was allotted a handsome revenue. The foundation of this establishment is attributed to Ptolemy Philadelphus, who here placed his library. Hence the word *museum* is now applied to any place set apart as a repository for things that have an immediate relation to the arts. Museum, Mushroom.

The museum at Oxford, called the *Ashmolean museum*, is a noble pile of building, erected at the expence of the university, at the west end of the theatre, at which side it has a magnificent portal, sustained by pillars of the Corinthian order. The front, which is to the street, extends about 60 feet, where there is this inscription over the entrance in gilt characters, *Museum Ashmoleanum, schola naturalis historiæ, officina chymica.* It was begun in 1679, and finished in 1683, when a valuable collection of curiosities was presented to the university by Elias Ashmole, Esq. which were the same day reposited there: several accessions have been since made to the museum; among which are hieroglyphics, and other Egyptian antiquities, an entire mummy, Roman antiquities, altars, medals, lamps, &c. and a variety of natural curiosities.

For an account of the British museum, see LONDON, N° 146.

MUSHROOM. See FUNGI, BOTANY *Index*.

To try the quality of mushrooms:—Take an onion, and strip the outer skin, and boil it with your mushrooms: if the onion become blue or black, there are certainly dangerous ones amongst them; if it remain white, they are good.

MUSIC.

Definition.

THE art of combining sounds in a manner agreeable to the ear. This combination may be either simultaneous or successive: in the first case, it constitutes harmony; in the last, melody. But though the same sounds, or intervals of sound, which give pleasure when heard in succession, will not always produce the same effect in harmony; yet the principles which constitute the simpler and more perfect kinds of harmony, are almost, if not entirely, the same with those of melody. By *perfect harmony*, we do not here mean that plenitude, those complex modifications of harmonic sound, which are admired in practice; but that harmony which is called *perfect* by theoricians and artists; that harmony which results from the coalescence of simultaneous sounds produced by vibrations in the proportions of thirds, fifths, and octaves, or their duplicates.

The principles upon which these various combinations of sound are founded, and by which they are regulated, constitute a science, which is not only extensive but profound, when we would investigate the principles from whence these happy modifications of sound result, and by which they are determined; or when we would explore the sensations, whether mental or corporeal, with which they affect us. The ancient definitions of music are not proportioned in their extent to our present ideas of that art; but M. Rouseau betrays a temerity highly inconsistent with the philosophical character, when from thence he infers, that their ideas were vague and undetermined. Every soul susceptible of refinement and delicacy in taste or sentiment, must be conscious that there is a music in action as well as in sound; and that the ideas of beauty and decorum, of harmony and symmetry, are, if we may use the expression, equally constituent of visible as of audible music. Those illustrious minds, whose comprehensive prospects in every science where taste and propriety prevail took in nature at a single glance, would behold with contempt and ridicule those narrow and microscopic views of which alone their successors in philosophy have discovered themselves capacious. With these definitions, however, we are less concerned, as they bear no proportion to the ideas which are now entertained of music. Nor can we follow M. Rousseau, from whatever venerable sources his authority may be derived, in adopting his Egyptian etymology for the word *music*. The established derivation from *Musa* could only be questioned by a paradoxical genius. That music had been practised in Egypt before it was known as an art in Greece, is indeed a fact which cannot be questioned; but it does not thence follow that the Greeks had borrowed the name as well as the art from Definition.

from Egypt. If the art of music be so natural to man that vocal melody is practised wherever articulate sounds are used, there can be little reason for deducing the idea of music from the whistling of winds through the reeds that grew on the river Nile. And indeed, when we reflect with how easy a transition we may pass from the accents of speaking to diatonic sounds; when we observe how early children adapt the language of their amusements to measure and melody, however rude; when we consider how early and universally these practices take place—there is no avoiding the conclusion, that the idea of music is connatural to man, and implied in the original principles of his constitution. We have already said, that the principles on which it is founded, and the rules by which it is conducted, constitute a science. The same maxims when applied to practice form an art: hence its first and most capital division is into *speculative* and *practical* music.

Speculative music is, if we may be permitted to use the expression, the knowledge of the nature and use of those materials which compose it, or, in other words, of all the different relations between the high and low, between the harsh and the sweet, between the swift and the slow, between the strong and the weak, of which sounds are susceptible: relations which, comprehending all the possible combinations of music and sounds, seem likewise to comprehend all the causes of the impressions which their succession can make upon the ear and upon the soul.

Practical music is the art of applying and reducing to practice those principles which result from the theory of agreeable sounds, whether simultaneous or successive; or, in other words, to conduct and arrange sounds according to the proportions resulting from consonance, from duration and succession, in such a manner as to produce upon the ear the effect which the composer intends. This is the art which we call *composition* *. With respect to the actual production of sounds by voices or instruments, which is called *execution*, this department is merely mechanical and operative: which, only presupposing the powers of sounding the intervals true, of exactly proportioning their degrees of duration, of elevating or depressing sounds according to those gradations which are prescribed by the tone, and to the value required by the time, demands no other knowledge but a familiar acquaintance with the characters used in music, and a habit of expressing them with promptitude and facility.

* See *Composition.*

Speculative music is likewise divided into two departments; viz. the knowledge of the proportions of sounds or their intervals, and that of their relative durations; that is to say, of measure and of time.

The first is what among the ancients seems to have been called *harmonical* music. It shows in what the nature of air or melody consists; and discovers what is consonant or discordant, agreeable or disagreeable, in the modulation. It discovers, in a word, the effects which sounds produce on the ear by their nature, by their force, and by their intervals; which is equally applicable to their consonance and their succession.

The second has been called *rhythmical*, because it treats of sounds with regard to their time and quantity. It contains the explication of their continuance, of their proportions, of their measures, whether long or short, quick or slow, of the different modes of time and the parts into which they are divided, that to these the succession of sounds may be conformed.

Practical music is likewise divided into two departments, which correspond to the two preceding.

That which answers to *harmonical* music, and which the ancients called *melopée*, teaches the rules for combining and varying the intervals, whether consonant or dissonant, in an agreeable and harmonious manner.

The second, which answers to the *rhythmical* music, and which they called *rhythmopée*, contains the rules for applying the different modes of time, for understanding the feet by which verses were scanned, and the diversities of measure; in a word, for the practice of the rhythmus.

Music is at present divided more simply into *melody* and *harmony*; for, since the introduction of *harmony*, the proportion between the length and shortness of sounds, or even that between the distance of returning cadences, are of less consequence amongst us. For it often happens in modern languages, that the verses assume their measures from the musical air, and almost entirely lose the small share of proportion and quantity which in themselves they possess.

By melody the successions of sound are regulated in such a manner as to produce pleasing airs. See MELODY.

Harmony consists in uniting to each of the sounds, in a regular succession, two or more different sounds, which simultaneously striking the ear soothe it by their concurrence. See HARMONY.

Music, according to Rousseau, may be, and perhaps likewise ought to be, divided into the *physical* and the *imitative*. The first is limited to the mere mechanism of sounds, and reaches no farther than the external senses, without carrying its impressions to the heart, and can produce nothing but corporeal sensations more or less agreeable. Such is the music of songs, of hymns, of all the airs which only consist in combinations of melodious sounds, and in general all music which is merely harmonious.

It may, however, be questioned, whether every sound, even to the most simple, is not either by nature or by early and confirmed association, *imitative*. If we may trust our own feelings, there is no such thing in nature as music which gives mechanical pleasure alone. For if so, it must give such pleasure as we receive from tastes, from odours, or from other grateful titillations; but we absolutely deny that there are any musical sensations or pleasures in the smallest degree analogous to these. Let any piece of music be resolved into its elementary parts and their proportions, it will then easily appear from this analysis, that sense is no more than the vehicle of such perceptions, and that mind alone can be susceptible of them. It may indeed happen, from the number of the performers and the complication of the harmony, that meaning and sentiment may be lost in the multiplicity of sounds; but this, though it may be harmony, loses the name of *music*.

The second department of this division, by lively and accentuated inflections, and by sounds which may be said to speak, expresses all the passions, paints every possible picture, reflects every object, subjects the whole of nature to its skilful imitations, and impresses even on the heart and soul of man sentiments proper to affect them in the most sensible manner. This, continues

nues he, which is the genuine lyric and theatrical music, was what gave double charms and energy to ancient poetry; this is what, in our days, we exert ourselves in applying to the drama, and what our singers execute on the stage. It is in this music alone, and not in harmonics or the resonance of nature, that we must expect to find accounts of those prodigious effects which it formerly produced.

But, with M. Rousseau's permission, all music which is not in some degree characterised by these pathetic and imitative powers, deserves no better name than that of a *musical jargon*, and can only be effectuated by such a complication and intricacy of harmony, as may confound, but cannot entertain the audience. This character, therefore, ought to be added as essential to the definition of music; and it must be attributed to our neglect of this alone, whilst our whole attention is bestowed on harmony and execution, that the best performances of our artists and composers are heard with listless indifference and oscitation, nor ever can conciliate any admirers, but such as are induced, by pedantry and affectation, to pretend what they do not feel. Still may the curse of indifference and inattention pursue and harrow up the souls of every composer or performer, who pretends to regale our ears with this musical legerdemain, till the grin of scorn, or the hiss of infamy, teach them to correct this depravity of taste, and entertain us with the voice of nature!

Whilst moral effects are sought in the natural effects of sound alone, the scrutiny will be vain, and disputes will be maintained without being understood: but sounds as representatives of objects, whether by nature or association, introduce new scenes to the fancy and new feelings to the heart; not from their mechanical powers, but from the connection established by the Author of our frame between sounds and the object which either by natural resemblance or unavoidable association they are made to represent.

It would seem that music was one of those arts which were first discovered: and that vocal was prior to instrumental music, if in the earliest ages there was any music which could be said to be purely instrumental. For it is more than probable, that music was originally formed to be the vehicle of poetry; and of consequence, though the voice might be supported and accompanied by instruments, yet music was never intended for instruments alone.

We are told by ancient authors, that all the laws, whether human or divine, exhortations to virtue, the knowledge of the characters and actions of gods and heroes, the lives and atchievements of illustrious men, were written in verse, and sung publicly by a quire to the sound of instruments; and it appears from the Scriptures, that such from the earliest times was the custom among the Israelites. Nor was it possible to find means more efficacious for impressing on the mind of man the principles of morals, and inspiring the love of virtue. Perhaps, however, this was not the result of a premeditated plan; but inspired by sublime sentiments and elevation of thought, which in accents that were suited and proportioned to their celestial nature endeavoured to find a language worthy of themselves and expressive of their grandeur.

It merits attention, that the ancients were duly sensible of the value and importance of this divine art, not only as a symbol of that universal order and symmetry which prevails through the whole frame of material and intelligent nature, but as productive of the most momentous effects both in moral and political life. Plato and Aristotle, who disagreed almost in every other maxim of politics, are unanimous in their approbation of music, as an efficacious instrument in the formation of the public character and in conducting the state; and it was the general opinion, that whilst the gymnastic exercises rendered the constitution robust and hardy, music humanised the character, and softened those habits of roughness and ferocity by which men might otherwise have degenerated into savages. The gradations by which voices were exerted and tuned, by which the invention of one instrument succeeded to another, or by which the principles of music were collected and methodised in such a manner as to give it the form of an art and the dignity of a science, are topics so fruitful of conjecture and so void of certainty, that we must leave them to employ minds more speculative and inventions more prolific than ours, or transfer them to the *History* of music as a more proper place for such disquisitions. For the amusement of the curious, Rousseau in his *Musical Dictionary*, Plates C and N, has transcribed some fragments of Grecian, Persian, American, Chinese, and Swiss music, with which performers may entertain themselves at leisure. When they have tried the pieces, it is imagined they will be less sanguinely fond than that author of ascribing the power of music to its affinity with the national accents where it is composed. This may doubtless have its influence; but there are other causes more permanent and less arbitrary to which it owes its most powerful and universal charms.

The music now most generally celebrated and practised is that of the Italians, or their successful imitators. The English, from the invasion of the Saxons, to that more late though lucid era in which they imbibed the art and copied the manner of the Italians, had a music which neither pleased the soul nor charmed the ear. The primitive music of the French deserves no higher panegyric. Of all the barbarous nations, the Scots and Irish seem to have possessed the most affecting original music. The first consists of a melody characterised by tenderness: It melts the soul to a pleasing pensive langnor. The other is the native expression of grief and melancholy. Tassoni informs us, that in his time a prince from Scotland had imported into Italy a lamentable kind of music from his own country; and that he himself had composed pieces in the same spirit. From this expressive though laconic description, we learn that the character of our national music was even then established; yet so gross is our ignorance and credulity, that we ascribe the best and most impassioned airs which are extant among us to David Rizzio; as if an Italian lutanist who had lived so short a time in Scotland, could, at once, as if were by inspiration, have imbibed a spirit and composed in a manner so different from his own. It is yet more surprising that Geminiani should have entertained and published the same prejudice, upon the miserable authority of popular tradition alone; for the fact is authenticated by no better credentials. The primitive music of the Scots may be divided into the *martial*, the *pastoral*, and the *festive*. The *first* consists either.

either in marches, which were played before the chieftains, in imitation of the battles which they fought, or in lamentations for the catastrophes of war and the extinction of families. These wild effusions of natural melody preserve several of the rules prescribed for composition. The strains, though rude and untutored, are frequently terrible or mournful in a very high degree. The port or march is sometimes in common, sometimes in treble time; regular in its measures, and exact in the distance between its returning cadences; most frequently, though not always, loud and brisk. The *pibroch*, or imitation of battles, is wild and abrupt in its transitions from interval to interval and from key to key; various and desultory in its movements; frequently irregular in the return of its cadences; and in short, through the whole, seems inspired with such fury and enthusiasm, that the hearer is irresistibly infected with all the rage of precipitate courage, notwithstanding the rudeness of the accents by which it is kindled. To this the *pastoral* forms a striking contrast. Its accents are plaintive, yet soothing; its harmony generally flat; its modulations natural and agreeable; its rhythmus simple and regular; its returning cadences at equal distance; its transitions from one concinnous interval to another, at least for the most part; its movements slow, and may be either in common or treble time. It scarcely admits of any other harmony than that of a simple bass. A greater number of parts would cover the air, and destroy the melody. To this we shall add what has been said upon the same subject by Dr Franklin. Writing to Lord K———, he proceeds thus:

"Give me leave, on this occasion, to extend a little the sense of your position, 'That melody and harmony are separately agreeable, and in union delightful;' and to give as my opinion, that the reason why the Scotch tunes have lived so long, and will probably live for ever (if they escape being stifled in modern affected ornament), is merely this, that they are really compositions of melody and harmony united, or rather that their melody is harmony. I mean, the simple tunes sung by a single voice. As this will appear paradoxical, I must explain my meaning. In common acceptation, indeed, only an agreeable *succession* of sounds is called *melody;* and only the *coexistence* of agreeable sounds *harmony*. But since the memory is capable of retaining for some moments a perfect idea of the pitch of a past sound, so as to compare it with the pitch of a succeeding sound, and judge truly of their agreement or disagreement, there may and does arise from thence a sense of harmony between the present and past sounds, equally pleasing with that between two present sounds. Now the construction of the old Scotch tunes is this, that almost every succeeding emphatical note is a third, a fifth, an octave, or in short some note that is in concord with the preceding note. Thirds are chiefly used, which are very pleasing concords. I use the word *emphatical*, to distinguish those notes which have a stress laid on them in singing the tune, from the lighter connecting notes that serve merely, like grammar-articles in common speech, to tack the whole together.

"That we have a most perfect idea of a sound just past, I might appeal to all acquainted with music, who know how easy it is to repeat a sound in the same pitch with one just heard. In tuning an instrument, a good ear can as easily determine that two strings are in unison by sounding them separately, as by sounding them together; their disagreement is also as easily, I believe I may say more easily and better distinguished when sounded separately; for when sounded together, though you know by the beating that one is higher than the other, you cannot tell which it is. I have ascribed to memory the ability of comparing the pitch of a present tone with that of one past. But if there should be, as possibly there may be, something in the ear similar to what we find in the eye, that ability would not be entirely owing to memory. Possibly the vibrations given to the auditory nerves by a particular sound may actually continue for some time after the cause of these vibrations is past, and the agreement or disagreement of a subsequent sound become by comparison with them more discernible. For the impression made on the visual nerves by a luminous object will continue for 20 or 30 seconds."

After some experiments to prove the permanency of visible impressions, he continues thus:

"Farther, when we consider by whom these ancient tunes were composed, and how they were first performed, we shall see that such harmonical succession of sounds was natural, and even necessary in their construction. They were composed by the minstrels of those days, to be played on the harp accompanied by the voice. The harp was strung with wire, which gives a sound of long continuance; and had no contrivance like that of the modern harpsichord, by which the sound of the preceding note can be stopt the moment a succeeding note begins. To avoid actual discord, it was therefore necessary that the succeeding emphatic note should be a chord with the preceding, as their sounds must exist at the same time. Hence arose that beauty in those tunes that has so long pleased, and will please for ever, though men scarce know why. That they were originally composed for the harp, and of the most simple kind, I mean a harp without any half notes but those in the natural scale, and with no more than two octaves of strings, from C to C, I conjecture from another circumstance; which is, that not one of these tunes really ancient, has a single artificial half-note in it; and that in tunes where it is most convenient for the voice to use the middle notes of the harp, and place the key in F, there the B, which if used should be a B flat, is always omitted, by passing over it with a third. The connoisseurs in modern music will say I have no taste; but I cannot help adding, that I believe our ancestors, in having a good song, distinctly articulated, sung to one of those tunes, and accompanied by the harp, felt more real pleasure than is communicated by the generality of modern operas, exclusive of that arising from the scenery and dancing. Most tunes of late composition, not having this natural harmony united with their melody, have recourse to the artificial harmony of a bass, and other accompanying parts. This support, in my opinion, the old tunes do not need, and are rather confused than aided by it. Whoever has heard *James Oswald* play them on his violincello, will be less inclined to dispute this with me. I have more than once seen tears of pleasure in the eyes of his auditors: and yet I think, even *his* playing those tunes would

would please more if he gave them less modern ornament."

As these observations are for the most part true, and always ingenious, we need no other apology for quoting them at length. It is only proper to remark, that the transition in Scots music by consonant intervals, does not seem, as Dr Franklin imagines, to arise from the nature of the instruments upon which they played. It is more than probable, that the ancient British harp was not strung with wire, but with the same materials as the Welsh harps at present. These strings have not the same permanency of tone as metal; so that the sound of a preceding emphatic note must have expired before the subsequent accented note could be introduced. Besides, they who are acquainted with the manœuvre of the Irish harp, know well that there is a method of discontinuing sounds no less easy and effectual than upon the harpsichord. When the performer finds it proper to interrupt a note, he has no more to do but return his finger gently upon the string immediately struck, which effectually stops its vibration.

That species of Scots music which we have distinguished by the name of *festive* seems now limited to reels and country-dances. These may be either in common or treble time. They most frequently consist of two strains: each of these contains eight or twelve bars. They are truly rhythmical; but the mirth which they excite seems rather to be inspired by the vivacity of the movement, than either by the force or variety of the melody. They possess a manœuvre and expression peculiar to themselves, which it is impossible to describe, and which can only be exhibited by good performers.

Having thus far pursued the general idea of music, we shall, after the history, give a more particular detail of the science.

HISTORY OF MUSIC.

No accurate accounts of the state of music in the earlier ages of the world.

MUSIC is capable of so infinite a variety, so greatly does the most simple differ from the most complex, and so multiplied are the degrees between these two extremes, that in no age could the incidents respecting that fascinating art have been few or uninteresting. But, that accounts of these incidents should have been handed down to us, scanty and imperfect, is no matter of surprise, when we recollect that the history of music is the history only of sounds, of which writing is a very inadequate medium; and that men would long employ themselves in the pleasing exercise of cultivating music before they possessed either the ability or the inclination to record their exertions.

No accurate traces, therefore, of the actual state of music, in the earlier ages of the world, can be discerned. Our ideas on the subject have no foundation firmer than conjecture and analogy.

It is probable, that among all barbarous nations some degree of similarity is discernible in the style of their music. Neither will much difference appear during the first dawnings of civilization. But in the more advanced periods of society, when the powers of the human mind are permitted without obstacle to exert their native activity and tendency to invention, and are at the same time affected by the infinite variety of circumstances and situations which before had no existence, and which in one case accelerate, and in another retard; then that similarity, once so distinguishable, gives place to the endless diversity of which the subject is capable.

Music not the invention of any one man.

The practice of music being universal in all ages and all nations, it would be absurd to attribute the invention of the art to any one man. It must have suffered a regular progression, through infancy, childhood, and youth, before it could arrive at maturity. The first attempts must have been rude and artless. Perhaps the first flute was a reed of the lake.

No nation has been able to produce proofs of antiquity so indisputable as the Egyptians. It would be vain, therefore, to attempt tracing music higher than the history of Egypt.

Egyptian music.

By comparing the accounts of Diodorus Siculus and of Plato, there is reason to suppose, that in very ancient times the study of music in Egypt was confined to the priesthood, who used it only on religious and solemn occasions; that, as well as sculpture, it was circumscribed by law; that it was esteemed sacred, and forbidden to be employed on light or common occasions; and that innovation in it was prohibited: But what the style or relative excellence of this very ancient music was, there are no traces by which we can form an accurate judgment. After the reigns of the Pharaohs, the Egyptians fell by turns under the dominion of the Ethiopians, the Persians, the Greeks, and the Romans. By such revolutions, the manners and amusements of the people, as well as their form of government, must have been changed. In the age of the Ptolemies, the musical games and contests instituted by those monarchs were of Greek origin, and the musicians who performed were chiefly Greek.

The most ancient monuments of human art and industry, at present extant at Rome, are the obelisks brought thither from Egypt, two of which are said to have been erected by Sesostris at Heliopolis, about 400 years before the siege of Troy. These were by the order of Augustus brought to Rome after the conquest of Egypt. One of them, called *guglia rotta*, or the broken pillar, which during the sacking of the city in 1527 was thrown down and broken, still lies in the Campus Martius. On it is seen the figure of a musical instrument of two strings, and with a neck. It resembles much the calascione still used in the kingdom of Naples.

An Egyptian musical instrument.

This curious relick of antiquity is mentioned, because it affords better evidence than, on the subject of ancient music, is usually to be met with, that the Egyptians, at so very early a period of their history, had advanced to a considerable degree of excellence in the cultivation of the arts. By means of its neck, this instrument was capable, with only two strings, of producing a great number of notes. These two strings, if tuned fourths to each other, would furnish that series of sounds called by the ancients *heptachord*, which

which consists of a conjunct tetrachord as B, C, D, E; E, F, G, A; if tuned fifths, they would produce an octave, or two disjunct tetrachords. The calascione is tuned in this last manner. The annals of no nation other than Egypt, for many ages after the period of the obelisk at Heliopolis, exhibit the vestige of any contrivance to shorten strings during performance by a neck or finger-board. Father Montfaucon observes, that after examining 500 ancient lyres, harps, and citharas, he could discover no such thing.

Egypt indeed seems to have been the source of human intelligence, and the favourite residence of genius and invention. From that celebrated country did the Greeks derive their knowledge of the first elements of those arts and sciences in which they afterwards so eminently excelled. From Greece again did the Romans borrow their attainments in the same pursuits. And from the records of those different nations have the moderns been enabled to accomplish so wonderful an improvement in literature.

The Egyptian Hermes the inventor of the lyre.

The Hermes or Mercury of the Egyptians, sirnamed *Trismegistus*, or *thrice illustrious*, who was, according to Sir Isaac Newton, the secretary of Osiris, is celebrated as the inventor of music. It has already been observed, that no one person ought strictly to be called the inventor of an art which seems to be natural to, and coeval with, the human species; but the Egyptian Mercury is without doubt entitled to the praise of having made striking improvements in music, as well as of having advanced in various respects the civilization of the people, whose government was chiefly committed to his charge. The account given by Apollodorus of the manner in which he accidentally invented the lyre, is at once entertaining and probable. "The Nile (says Apollodorus), after having overflowed the whole country of Egypt, when it returned within its natural bounds, left on the shore a great number of dead animals of various kinds, and among the rest a tortoise; the flesh of which being dried and wasted by the sun, nothing remained within the shell but nerves and cartilages, and these being braced and contracted by the drying heat became sonorous. Mercury walking along the banks of the Nile, happened to strike his foot against this shell; and was so pleased with the sound produced, that the idea of a lyre started into his imagination. He constructed the instrument in the form of a tortoise, and strung it with the dried sinews of dead animals."

How beautiful to conceive the energetic powers of the human mind in the early ages of the world, exploring the yet undiscovered capabilities of nature, and directed to the inexhaustible store by the finger of God in the form of accident!

The single flute of the Egyptians.

The monaulos, or single flute, called by the Egyptians photinx, was probably one of the most ancient instruments used either by them or any other nation. From various remains of ancient sculpture, it appears to have been shaped like a bull's horn, and was at first, it may be supposed, no other than the horn itself.—Before the invention of flutes, as no other instrument except those of percussion were known, music must have been little more than metrical. When the art of refining and lengthening sounds was first discovered, the power of music over mankind, from the agreeable surprise occasioned by soft and extended notes, was probably irresistible. At a time when all the rest of the world was involved in savage ignorance, the Egyptians were possessed of musical instruments capable of much variety and expression.—Of this the astonishing remains of the city Thebes still subsisting afford ample evidence. In a letter from Mr Bruce, ingrossed in Dr Burney's history of Music, there is given a particular description of the Theban harp, an instrument of extensive compass, and exquisite elegance of form. It is accompanied with a drawing taken from the ruins of an ancient sepulchre at Thebes, supposed by Mr Bruce to be that of the father of Sesostris. The Theban harp of Egypt.

On the subject of this harp, Mr Bruce makes the following striking observation. It overturns all the accounts of the earliest state of ancient music and instruments in Egypt, and is altogether, in its form, ornaments, and compass, an incontestable proof, stronger than a thousand Greek quotations, that geometry, drawing, mechanics, and music, were at the greatest perfection when this harp was made; and that what we think in Egypt was the invention of arts was only the beginning of the æra of their restoration."

Indeed, when the beauty and powers of this harp, along with the very great antiquity of the painting which represents it, are considered, such an opinion as that which Mr Bruce hints at, does not seem to be devoid of probability.

It cannot be doubted that during the reigns of the Ptolemies, who were voluptuous princes, music must have been much cultivated and encouraged. The father of Cleopatra, who was the last of that race of kings, derived his title of auletes, or flute-player, from his excessive attachment to the flute. Like Nero, he used to array himself in the dress of a tibicen, and exhibit his performance in the public musical contests.

Some authors, particularly Am. Marcellinus and M. Pau, refuse to the Egyptians, at any period of their history, any musical genius, or any excellence in the art; but the arguments used to support this opinion seem to be inconclusive, and the evidences of the opposite decision appear to be incontestable.

The sacred Scriptures afford almost the only materials from which any knowledge of Hebrew music can be drawn. In the rapid sketch, therefore, of ancient music which we mean to exhibit, a very few observations are all which can properly be given to that department of our subject. Hebrew Music.

Moses, who led the Israelites out of Egypt, was educated by Pharaoh's daughter in all the literature and elegant arts cultivated in that country. It is probable, therefore, that the taste and style of Egyptian music would be infused in some degree into that of the Hebrews. Music appears to have been interwoven through the whole tissue of religious ceremony in Palestine. The priesthood seem to have been musicians hereditary and by office. The prophets appear to have accompanied their inspired effusions with music; and every prophet, like the present improvisatori of Italy, seems to have been accompanied by a musical instrument.

Music, vocal and instrumental, constituted a great part of the funeral ceremonies of the Jews. The pomp and expence used on these occasions advanced by degrees to an excessive extent. The number of flute-players in the processions amounted sometimes to several hundreds,

hundreds, and the attendance of the guests continued frequently for 30 days *.

* *Josephus*, lib iii c. 9.

The Hebrew language abounds with consonants, and has so few vowels, that in the original alphabet they had no characters. It must, therefore, have been harsh and unfavourable to music. Their instruments of music were chiefly those of percussion; so that, both on account of the language and the instruments, the music must have been coarse and noisy. The vast numbers of performers too, whom it was the taste of the Hebrews to collect together, could with such a language and such instruments produce nothing but clamour and jargon. According to Josephus, there were 200,000 musicians at the dedication of Solomon's temple. Such are the circumstances from which only an idea of Hebrew music can be formed; for the Jews, neither ancient nor modern, have ever had any characters peculiar to music; and the melodies used in their religious ceremonies have at all times been entirely traditional.

coarse and noisy.

Grecian music.

Cadmus, with the Phœnician colony which he led into Greece, imported at the same time various arts into that country. By the assistance of his Phœnician artificers, that chief discovered gold in Thrace and copper at Thebes. At Thebes that metal is still termed *cadmia*. Of these materials, and of iron, they formed to themselves armour and instruments of war. These they struck against each other during their dances at sacrifices, by which they first obtained the idea of music. Such is the account given of the origin of that species of music in Greece produced by instruments of percussion. The invention of wind instruments in Greece is attributed to Minerva; and to the Grecian Mercury is assigned, by the poets and historians of that country, the honour of many discoveries probably due to the Egyptian Hermes, particularly the invention of stringed instruments. The lyre of the Egyptian Mercury had only three strings; that of the Grecian seven: The last was perhaps no more than an improvement on the other. When the Greeks deified a prince or hero of their own country, they usually assigned him an Egyptian name, and with the name bestowed on their new divinity all the actions, attributes, and rites of the original.

The Grecian lyre, although said to have been invented by Mercury, was cultivated principally by Apollo, who first played upon it with method, and accompanied it with the voice. The celebrated contest between him and Marsyas is mentioned by various authors; in which, by conjoining the voice with his lyre (a combination never before attempted), his music was declared superior to the flute of Marsyas. The progress of the lyre, according to Diodorus Siculus, is the following. "The muses added to the Grecian lyre the string called *mese*; Linus that of lichanos; and Orpheus and Thamyras those strings which are named hypate and parhypate." It has been already mentioned, that the lyre invented by the Egyptian Mercury had but three strings. By putting these circumstances together, we may perhaps acquire some knowledge of the progress of music, or at least of the extension of its scale in the highest antiquity. *Mese*, in the Greek music, is the fourth sound of the second tetrachord of the great system, and first tetrachord invented by the ancients, answering to our A, on the fifth line in the base. If this sound then was added to the former three, it proves that the most ancient tetrachord was that from E in the base to A; and that the three original strings in the Mercurian and Apollonian lyre were tuned E, F, G, which the Greeks call *hypate meson*, *parhyate meson*, and *meson diatonos*: The addition, therefore, of *mese* to these, completed the first and most ancient tetrachord E, F, G, A. The string lichanos again being added to these, and answering to our D on the third line in the base, extended the compass downwards, and gave the ancient lyre a regular series of five sounds. The two strings hypate and parhypate, corresponding with our B and C in the base, completed the heptachord or seven sounds b, c, d, e, f, g, a; a compass which received no addition till after the days of Pindar.

Progress of the Grecian lyre.

It might perhaps be expected, that in a history of Greek music something ought to be said concerning the muses, Apollo, Bacchus, and the other gods and demi-gods, who in the mythology of that country appear to have promoted and improved the art. But such a discussion would be too diffusive, and involve too much foreign matter for the plan we have chosen to adopt. We cannot avoid, however, making a few observations on the poems of Homer, in so far as connected with our subject. It has been imagined, with much appearance of probability, that the occupation of the first poets and musicians of Greece resembled that of the Celtic and German bards and the scalds of Iceland and Scandinavia. They sung their poems in the streets of the cities and in the palaces of princes. They were treated with high respect, and regarded as inspired persons. Such was the employment of Homer. His poems, so justly celebrated, exhibit the most authentic picture that can be found in the annals of antiquity, although perhaps somewhat highly coloured, of the times of which he wrote and in which he lived. Music is always named throughout the Iliad and Odyssey with rapture; but as in these poems no mention is made of instrumental music unaccompanied with poetry and singing, a considerable share no doubt of the poet's praises is to be attributed to the poetry. The instruments most frequently named are the lyre, the flute, and the syrinx. The trumpet appears not to have been known at the siege of Troy, although it had come to be in use in the days of Homer himself. From the time of Homer till that of Sappho, there is almost a total blank in literature. Only a few fragments remain of the works of those poets and musicians whose names are preserved as having flourished between those periods (A). During the century which elapsed between the days of Sappho and those of Anacreon, no literary productions are preserved entire.—

Occupation of the first poets and musicians in Greece.

(A) Hesiod lived so near to Homer, that it has been disputed which of them is the most ancient. It is now, we believe, universally admitted, that the palm of antiquity is due to Homer; but we consider them as having both flourished in the same era.

From Anacreon to Pindar there is another chasm of near a century. Subsequent to this time, the works still extant of the three great tragic poets, Æschylus, Sophocles, and Euripides, together with those of Plato, Aristotle, Aristoxenus, Euclid, Theocritus, Callimachus, Polybius, and many others, produced all within a space less than 300 years, distinguish this illustrious and uncommon period as that in which the whole powers of genius seem to have been exerted to illuminate and instruct mankind in future ages. Then it was that eloquence, poetry, *music*, architecture, history, painting, sculpture, like the spontaneous blossoms of nature, flourished without the appearance of labour or of art.

The poets, as well epic as lyric and elegiac, were all likewise musicians; so strictly connected were music and poetry for many ages. It would afford amusement to collect the biographical anecdotes of these favourites of genius, and to assign to each the respective improvements made by him in music and poetry; but our limits do not admit of so extensive a disquisition; for which, therefore, reference must be made to the editors and commentators of these authors, and to the voluminous histories of music lately published.

The invention of musical characters.

The invention of notation and musical characters marked a distinguished æra in the progress of music. There are a diversity of accounts respecting the person to whom the honour of that invention is due; but the evidences seem to preponderate in favour of Terpander, a celebrated poet and musician, to whose genius music is much indebted. He flourished about the 27th Olympiad, or 671 years before Christ.

Before that valuable discovery, music being entirely traditional, must have depended much on the memory and taste of the performer.

There is an incident mentioned in the accounts handed down to us of the Olympic games, which may serve in some degree to mark the character of music at the time in which it happened. Lucian relates that a young flute-player named Harmonides, at his first public appearance in these games, began a solo with so violent a blast, on purpose to *surprise* and *elevate* the audience, that he *breathed his last breath into his flute*, and died on the spot. When to this anecdote, wonderful to us, and almost incredible, is added that circumstance, that the trumpet-players at these public exhibitions expressed an excess of joy when they found their exertions had neither rent their cheeks nor burst their blood-vessels, some idea may be formed of the noisy and vociferous style of music which then pleased; and from such facts only can any opinion be obtained of the actual state of ancient music.

Vociferous music of the Greeks.

In whatever *manner* the flute was played on, there is no doubt that it was long in Greece an instrument of high favour, and that the flute-players were held in much estimation. The flute used by Ismenias, a celebrated Theban musician, cost at Corinth three talents, or 581l. 5s. If, says Xenophon, a bad flute-player would pass for a good one, he must, like the *great flute-players*, expend large sums on *rich furniture*, and appear in public *with a great retinue of servants*.

The ancients, it appears, were not less extravagant in gratifying the ministers of their pleasures than ourselves. Amœbæus, a harper, was paid an Attic talent, or 193l. 15s. per day for his performance (B).

Extravagance of the ancients with respect to music.

It is proper to add, that the celebrated musicians of Greece who performed in public were of *both* sexes; and that the beautiful Lamia, who was taken captive by Demetrius, in the sea engagement in which he vanquished Ptolemy Soter, and who herself captivated her conqueror, was a public performer, as well as were many other elevated female spirits, who are recorded by ancient authors in terms of admiration, and of whom, did our limits here admit of biography, we would treat with pleasure. The philosophers of Greece, whose capacious minds grasped every other object of human intelligence, were not inattentive to the theory of music, or the philosophy of sound. This department of science became the source of various sects, and of much diversity of opinion.—The founders of the most distinguished sects were Pythagoras and Aristoxenus.

Roman music.

Like every other people, the Romans, from their first origin as a nation, were possessed of a species of music which might be distinguished as their own. It appears to have been rude and coarse, and probably was a variation of the music in use among the Etrusceans and other tribes around them in Italy; but as soon as they began to open a communication with Greece, from that country, with their arts and philosophy, they borrowed also their music and musical instruments. No account, therefore, of Roman music is to be expected that would not be a repetition of what has been said on the subject of the music of Greece.

Vanity of Nero with respect to music.

The excessive vanity of Nero with respect to music, displayed in his public contentions for superiority with the most celebrated professors of the art in Greece and Rome, is known to every one conversant in the history of Rome. The solicitude with which that detestable tyrant attended to his voice is curious, and will throw some light on the practices of singers in ancient times. He was in use to lie on his back, with a thin plate of lead on his stomach. He took frequent emetics and cathartics, abstained from all kinds of fruits and such meats as were held to be prejudicial to singing. Apprehensive of injuring his voice, he at length desisted from haranguing the soldiery and the senate; and after his return from Greece established an officer (Phonascus) to regulate his tones in speaking.

Sacred music.

Most nations have consented in introducing music into their religious ceremonies. That art was early admitted into the rites of the Egyptians and Hebrews; and that it constituted a considerable part of the Grecian and Roman religious service, appears from the writings of many ancient authors. The same pleasing art soon obtained an introduction into the Christian church, as the Acts of the Apostles discover in many passages. There remain no specimens of the music employed in the worship of the primitive Christians; but probably it was at first the same with that used in the Pagan rites of the Greeks and Romans. The practice

(B) Roscius gained 500 sestertia, or 4036l. 9s. 2d. sterling.

practice of chanting the psalms was introduced into the western churches by St Ambrose, about 350 years after Christ. In the year 600, the method of chanting was improved by St Gregory the Great. The Ambrosian chant contained four modes. In the Gregorian the number was doubled. So early as the age of Coustantine the Great, prior to either of the periods last mentioned, when the Christian religion first obtained the countenance of power, instrumental music came to be introduced into the service of the church.

introduced into the English church.

In England, according to Bishop Stillingfleet, music was employed in the church service, first by St Augustine, and afterwards much improved by St Dunstan, who was himself an eminent musician, and who is said to have first furnished the English churches and convents with the organ. The organ, the most majestic of all instruments, seems to have been an improvement of the hydraulican or water organ of the Greeks.—The first organ seen in France was sent from Constantinople in 757, as a present to King Pepin from the emperor Constantine Copronymus VI. In Italy, Germany, and England, that instrument became frequent during the 10th century.

During the dark ages no work of genius or taste in any department of science seems to have been produced in any part of Europe; and except in Italy, where the cultivation of music was rather more the object of attention, that art was neglected equally with all others. There has always been observed a correspondence in every country between the progress of music and the cultivation of other arts and sciences. In the middle ages, therefore, when the most fertile provinces of Europe were occupied by the Goths, Huns, Vandals, and other barbarous tribes, whose language was as harsh as their manners were savage, little perfection and no improvement of music is to be looked for. Literature, arts, and refinements, were encouraged more early at the courts of the Roman pontiffs than in any other country; and owing to that circumstance it is, that the scale, the counterpoint, the best melodies, the dramas religious and secular, the chief graces and elegancies of modern music, have derived their origin from Italy. In modern times, Italy has been to the rest of Europe what ancient Greece was to Rome. The Italians have aided the civilization of their conquerors, and enlightened the minds of those whose superior prowess had enslaved them.

The great improvements in music had their origin in Italy.

Having mentioned counterpoint, it would be improper not to make one or two observations on an invention which is supposed to have been the source of great innovation in the practice of music. Counterpoint, or music in parts, seem to be an invention purely modern. The term harmony meant in the language of antiquity what is now understood by melody. Guido, a monk of Arezzo in Tuscany, is, in the general opinion, supposed to have entertained the first idea of counterpoint about the year 1022: an art which, since his time, has experienced gradual and imperceptible improvements, far exceeding the powers or comprehension of any one individual. The term *counterpoint*, or *contra punctum*, denotes its own etymology and import. Musical notation was at one time performed by small points; and the present mode is only an improvement of that practice. Counterpoint, therefore, denotes the notation of harmony or music in parts, by points opposite to each other. The improvements of this important acquisition to the art of music kept pace at first with those of the organ; an instrument admirably adapted to harmony: And both the one and the other were till the 13th century employed chiefly in sacred music. It was at this period that sacred music began to be cultivated.

Counterpoint.

Before the invention of characters for time, music in parts must have consisted entirely of *simple counterpoint*, or note against note, as is still practised in psalmody. But the happy discovery of a time-table extended infinitely the powers of combined sounds. The ancients had no other resource to denote time and movement in music except two characters (— ⏑), equivalent to a long and a short syllable. But time is of such importance in music, that it can impart meaning and energy to the repetition of the same sound. Without it variety of tones has no effect with respect to gravity and acuteness. The invention of the time-table is attributed by almost all the writers on music of the last and present century to John de Muris, who flourished about the year 1330. But in a manuscript of John de Muris himself, bequeathed to the Vatican library by the Queen of Sweden, that honour seems to be yielded to Magister Franco, who appears to have been alive as late at least as 1083. John de Muris, however, who there is some cause to believe was an Englishman, though not the inventor of the *cantus mensurabilis*, did certainly by his numerous writings greatly improve it. His tract on the *Art of Counterpoint* is the most clear and useful essay on the subject of which those times can boast.

The invention of the time-table.

In the 11th century, during the first crusade, Europe began to emerge from the barbarous stupidity and ignorance which had long overwhelmed it. While its inhabitants were exercising in Asia every species of rapine and pious cruelty, art, ingenuity, and reason, insensibly civilized and softened their minds. Then it was that the poets and songsters, known by the name of *Troubadours*, who first appeared in Provence, instituted a new profession; which obtained the patronage of the count of Poictou, and many other princes and barons, who had themselves cultivated music and poetry with success. At the courts of their munificent patrons the troubadours were treated with respect. The ladies, whose charms they celebrated, gave them the most generous and flattering reception. The success of some inspired others with hopes, and excited exertions in the exercise of their art; impelling them towards perfection with a rapidity which the united force alone of emulation and emolument could occasion. These founders of modern versification, constructing their songs on plans of their own, classical authority, either through ignorance or design, was entirely disregarded. It does not appear, however, during the cultivation and favour of Provençal literature, that any one troubadour so far outstripped the rest as to become a model of imitation. The progress of taste must ever be impeded by the ignorance and caprice of those who cultivate an art without science or principles.

Troubadours.

During almost two centuries after the arrangement of

of the scale attributed to Guido, and the invention of the time-table ascribed to Franco, no remains of secular music can be discovered, except those of the troubadours or Provençal poets. In the simple tunes of these bards no time indeed is marked, and but little variety of notation appears: It is not difficult, however, to discover in them the germs of the future melodies, as well as the poetry of France and Italy. Had the poetry and music of the troubadours been treated of in an agreeable manner by the writers who have chosen that subject, it would have been discovered to be worthy of attention; the poetry, as interesting to literature; the melody to which it was sung, as curious to the musical historian.

Almost every species of Italian poetry is derived from the Provençals. *Air*, the most captivating part of secular vocal music, seems to have had the same origin. The most ancient strains that have been spared by time, are such as were set to the songs of the troubadours. The Provençal language began to be in favour with poets about the end of the 10th century. In the 12th it became the general vehicle, not only of poetry, but of prose, to all who were ignorant of Latin. And these were not the laity only. At this period *violars*, or performers on the vielle or viol, *juglars*, or flute-players, *musars* or players on other instruments, and *comics* or comedians, abounded all over Europe. This swarm of poet-musicians, who were formerly comprehended in France under the general title of *jongleurs*, travelled from province to province, singing their verses at the courts of princes. They were rewarded with clothes, horses, arms, and money. Jongleurs or musicians were employed often to sing the verses of troubadours, who themselves happened to be deficient in voice or ignorant of music. The term *troubadour*, therefore, implies poetry as well as music. The jongleurs, menetriers, strollers, or minstrels, were frequently musicians, without any pretensions to poetry. These last have been common at all times; but the troubadour or bard has distinguished a particular profession, either in ancient or modern times, only during the early dawnings of literature.

In the 13th century the songs were on various subjects; moral, merry, amorous: and at that time melody seems to have been little more than plain song or chanting. The notes were square, and written on four lines only like those of the Romish church in the cliff C, and without any marks for time. The movement and embellishments of the air depended on the abilities of the singer. Since that time, by the cultivation of the voice modern music has been much extended, for it was not till towards the end of St Lewis's reign that the fifth line began to be added to the stave. The singer always accompanied himself with an instrument in unison.

The harp the favourite instrument of the Troubadours.

As the lyre is the favourite instrument in Grecian poetry, so the harp held the same place in the estimation of the poets who flourished in the period of which we at present speak. A poet of the 14th century, Machau, wrote a poem on the subject of the harp alone; in which he assigns to each of its 25 strings an allegorical name; calling one *liberality*, another *wealth*, &c.

The viol or violin.

The instrument which frequently accompanied, and indeed disputed the pre-eminence with the harp, was the viol. Till the 16th century this instrument was furnished with frets; after that period it was reduced to four strings: and still under the denomination of *violin* holds the first place among the treble instruments. The viol was played with a bow, and differed entirely from the vielle, the tones of which were produced by the friction of a wheel: The wheel performed the part of a bow.

British harpers were famous long before the conquest. The bounty of William of Normandy to his *joculator* or bard is recorded in the Doomsday book. The harp seems to have been the favourite instrument in Britain for many ages, under the British, Saxon, Danish, and Norman kings. The *fiddle*, however, is mentioned so early as 1200 in the legendary life of St Christopher. The ancient privileges of the minstrels at the fairs of Chester are well known in the history of England.

The extirpation of the bards of Wales by Edward I. is likewise too familiar an incident to be particularly mentioned here. His persecuting spirit, however, seems to have been limited to that principality; for we learn, that at the ceremony of knighting his son, a *multitude of minstrels* attended.

In 1315, during the reign of Edward II. such extensive privileges were claimed by the minstrels, and so many dissolute persons assumed that character, that it became necessary to restrain them by express laws.

The father of our genuine poetry, who in the 14th century enlarged our vocabulary, polished our numbers, and with acquisitions from France and Italy augmented our store of knowledge (Chaucer), entitles one of his poems The History of St Cecilia; and the celebrated patroness of music must no doubt be mentioned in a history of the art. Neither in Chaucer, however, nor in any of the histories or legendary accounts of this saint, does any thing appear to authorize the religious veneration paid to her by the votaries of music; nor is it easy to discover whence it has arisen. St Cecilia.

As an incident relative to the period of which we speak, it may be mentioned, that, according to Spelman, the appellation of *Doctor* was not among the degrees granted to graduates in England sooner than the reign of King John, about 1207; although, in Wood's history of Oxford, that degree is said to have been conferred, even in music, in the reign of Henry II. It is known that the title was created on the continent in the 12th century; and as, during the middle ages, music was always ranked among the seven liberal arts, it is likely that the degree was extended to it. Origin of the degree of Mus. D.

After the invention of printing, an art which has tended to disseminate knowledge with wonderful rapidity among mankind, music, and particularly counterpoint, became an object of high importance. The names of the most eminent composers who flourished in England, from that time to the Reformation, were, Fairfax, William of Newark, Sheryngham, Turges, Banister, Tudor, Taverner, Tye, Johnson, Parsons; to whom may be added John Marbeck, who set the whole English cathedral service to music.

Before this period Scottish music had advanced to a high degree of perfection. James I. was a great composer of airs to his own verses; and may be considered Scottish music.

dered as the father of that plaintive melody which in Scotch tunes is so pleasing to a taste not vitiated by modern affectation. Besides the testimony of *Fordun* and *Major*, who may be suspected of being under the influence of national prejudice, we have that of Alessandro Tessani, to the musical skill of that accomplished prince. "Among us moderns (says this foreigner) we may reckon *James king of Scotland*, who not only composed many sacred pieces of vocal music, but also of himself *invented a new kind of music, plaintive and melancholy, different from all others;* in which he has *been imitated* by Carlo Gesualdo prince of Venosa, who in our age has improved music with new and admirable inventions."

Under such a genius in poetry and music as King James I. it cannot be doubted that the national music must have been greatly improved. We have seen that he composed several anthems, or vocal pieces of *sacred music*, which shows that his knowledge of the science must have been very considerable. It is likewise known, that organs were by him introduced into the cathedrals and abbeys of Scotland, and choir-service brought to such a degree of perfection, as to fall little short of that established in any country of Europe.—By an able and ingenious antiquary * the great era of music, as of poetry, in Scotland, is supposed to have been from the beginning of the reign of James I. down to the end of the reign of James V. During that period flourished *Gavin Douglas* bishop of Dunkeld, *Ballenden* archdeacon of Murray, *Dunbar*, *Henryson*, *Scott*, *Montgomery*, *Sir David Lindsey*, and many others, whose fine poems have been preserved in Bannatyne's Collection, and of which several have been published by Allan Ramsay in his *Evergreen*.

* See *Tytler's Dissertation on the Scotch Music*, vol i of the Transactions of the Society of Antiquaries in Scotland.

Before the Reformation, as there was but one religion, there was but one kind of sacred music in Europe, plain chant, and the descant built upon it.—That music likewise was applied to one language only, the Latin. On that account, the compositions of Italy, France, Spain, Germany, Flanders, and England, kept pace in a great degree with each other in style and excellence. All the arts seem to have been the companions, if not the produce, of successful commerce: they appeared first in Italy, then in the Hanseatic towns, next in the Netherlands; and during the 16th century, when commerce became general in every part of Europe.

In the 16th century music an indispensable part of education.

In the 16th century music was an indispensable part of polite education: All the princes of Europe were instructed in that art. There is a collection preserved in manuscript called *Queen Elizabeth's Virginal Book*. If her majesty was able to execute any of the pieces in that book, she must have been a great player; a month's practice would not be sufficient for any master now in Europe to enable him to play one of them to the end. *Tallis*, singularly profound in musical composition, and *Bird* his admirable scholar, were two of the authors of this famous collection.

During the reign of Elizabeth, the genius and learning of the British musicians were not inferior to any on the continent; an observation scarcely applicable at any other period of the history of this country. Sacred music was the principal object to study all over Europe.

The most eminent musical theorists of Italy, who flourished in the 16th century, were, Franchinus Gafierius, or Gafforio of Lode, Pietro Aaron of Florence, Lodovico Fogliano, Giov. Spatro, Giov. Maria da Terentio Lanfranco, Steffano Uanneo, Anton. Francisco Done, Luigi Dentice, Nicolo Vicentino, and Gioseffo Zarlino, the most general, voluminous, and celebrated theorist of that period, Vincentio Galilei, a Florentine nobleman, and father of the great Galileo Galilei, Maria Artuse of Bologna, Orasco Tegrini, Pietro Pontio, and Lodovico Zacconi.

Eminent musicians in Italy during the 16th century.

The principal Roman authors were, Giovanni Anmuccia, Giovanni Pierluigi da Palestrina, justly celebrated, Ruggiero Giovanelli, Luca Marenzio, who brought to perfection madrigals, the most cheerful species of secular music.

Of the Venetians, Adrian Willaert is allowed to be at the head.

At the head of the Neapolitans is deservedly placed Rocco Rodio.

At Naples, too, the illustrious dilettante, Don Carlo Gesualdo prince of Venosa, is highly celebrated. He seems, however, to have owed much of his fame to his high rank.

Lombardy might also furnish an ample list of eminent musicians during the 16th century, of whom, however, our limits will not admit of a particular enumeration:—The chief of them were, Constanzo Porta, Gastoldi, Bissi, Cima, Vecchi, and Monteverde.

At Bologna, besides Artusi already mentioned, Andrea Rota of the same city appears to have been an admirable contrapunctist.

Francisco Corteccia, a celebrated organist and composer, and Alessandro Strigglio, a lutanist and voluminous composer, were the most eminent Florentines.

The inhabitants of the extensive empire of Germany have long made music a part of general education.—They hold the place, next to Italy, among the most successful cultivators of the art. During the 16th century, their most eminent composers of music and writers on the subject were, Geo. Reischius, Michael Roswick, Andreas Ornithorparchus, Paul Hofhaimer, Luspeinius, Henry Loris or Lorit, Faber, Fink, Hosman, and many others whom it would be tedious to mention; and for a particular account of whose treatises and compositions we must refer to more voluminous histories of music.

In Germany.

In France, during the 16th century, no art except the art of war made much progress in improvement.—Ronsard, Baif, Goudimel, Claud le Jeune, Caurroy, and Maudit, are the chief French musicians of that period.

In France.

In Spain, music was early received into the circle of sciences in the universities. The musical professorship at Salamanca was founded and endowed by Alfonzo the Wise, king of Castile.

Spain.

One of the most celebrated of the Spanish musicians was Francis Salinas, who had been blind from his infancy. He was a native of Burgos.

D. Cristofero Morales, and Tomaso Lodovico da Vittorio, deserve likewise to be mentioned; and to mention them is all we can attempt; the purpose of which is, to excite more minute inquiry by those who may choose to investigate the subject particularly.

The Netherlands, likewise, during the period of which we have been speaking, produced eminent composers; The Netherlands of

of whom we may mention Verletot, Gombert, Arkadelt, Berchem, Richefort or Ricciafort, Crequilon Le Cock or Le Coq, Canis, Jacob Clemens Non Papa, Pierre Manchicourt, Baston, Kerl, Rore, Orlandi di Lasso, and his sons Ferdinand and Rodolph.

Musical composers in England during the 17th century.

In the 17th century, the musical writers and composers who acquired fame in England, were, Dr Nathanael Giles, Thomas Tomkins, and his son of the same name; Elway Bevin, Orlando Gibbons, Dr William Child, Adrian Batten, Martin Pierson, William Lawes, Henry Lawes, Dr John Wilson, John Hilton, John Playford, Captain Henry Cook, Pelham Humphrey, John Blow, William Turner, Dr Christopher Gibbons, Benjamin Rogers, and Henry Purcell. Of these, Orlando Gibbons, Pelham Humphrey, and Henry Purcell, far excelled the rest.

About the end of the reign of James I. a music-lecture or professorship was founded in the university of Oxford by Dr William Hychin.

In the reign of Charles I. a charter was granted to the musicians of Westminster, incorporating them, as the king's musicians, into a body politic, with powers to prosecute and fine all who, except themselves, should "attempt to make any benefit or advantage of music in England or Wales;" powers which in the subsequent reign were put in execution.

About the end of the reign of Charles II. a passion seems to have been excited in England for the violin, and for pieces expressly composed for it, in the Italian manner (B). Prior to 1600, there was little other music except masses and madrigals, the two principal divisions of sacred and secular music; but from that time to the present, dramatic music becomes the chief object of attention. The music of the church and of the chamber continued indeed to be cultivated in Italy with diligence, and in a learned and elaborate style, till near the middle of the century; yet a revolution in favour of melody and expression was preparing, even in sacred music, by the success of dramatic composition, consisting of recitation and melodies for a single voice. Such melodies began now to be preferred to music of many parts; in which canons, fugues, and full harmony, had been the productions which chiefly employed the master's study and the hearer's attention.

Mean state of the opera in the beginning of the 18th century.

So late as the beginning of the 18th century, according to Riccoboni, the performers in the operas of Germany, particularly at Hamburg, "were all tradesmen or handicrafts. Your shoemaker (says he) was often the first performer on the stage; and you might have bought fruit and sweetmeats of the same girls, whom the night before you had seen in the characters of Armida or Semiramis. Soon, however, the German opera arose to a more respectable situation, and even during the 17th century many eminent composers flourished in that country."

State of music in France in the 17th century.

The list of great musicians which France produced during the early part of the same century is not numerous. Music seems to have been but little cultivated in that country, till the operas of Lulli, under the powerful patronage of Louis XIV. excited public attention.

The favourite singing-master and composer of France, about the middle of the 17th century, was Michael Lambert. John Baptist Lulli, soon after this time, rose from the rank of a menial servant to fame, opulence, and nobility, by his skill in musical compositions. The celebrated singer La Rochois was taught singing and acting by Lulli.

Curious anecdotes of a French singer.

La Maupin the successor of La Rochois, on account of her extraordinary character and romantic adventures, deserves to be mentioned. She eloped from her husband with a fencing-master, of whom she learnt the small sword. She became an excellent fencer. At Marseilles she entertained a strange attachment to a young lady, who was seized with a whimsical fondness in return, on account of which the latter was confined in a convent. La Maupin obtained admission into the same convent as a novice. She set fire to the building, and in the confusion carried off her favourite. At Paris when she appeared on the stage in 1695, Dumeni a singer having affronted her, she put on men's clothes, and insisted on his drawing his sword and fighting her. When he refused, she caned him, and took from him his watch and snuff-box as trophies of her victory. At a ball given by Monsieur brother of Louis XIV. she again put on men's clothes; and having behaved impertinently to a lady, three of the lady's friends, supposing La Maupin to be a man, called her out. She killed them all; and returning coolly to the ball, told the story to Monsieur, who obtained her pardon. She became afterwards mistress to the elector of Bavaria. This prince quitting her for the countess of Arcos, sent her by the count, husband of that lady, a purse of 40,000 livres. She threw it at the count's head, telling him, it was a recompense worthy of such meanness as he displayed. At last, seized with a fit of devotion, she recalled her husband, and spent the remainder of her life in piety. She died in 1707 at the age only of 34.

Chief composers for the church in England.

The English musician whom we last mentioned was the celebrated Purcell. After his time the chief composers for the church were Clarke, Dr Holden, Dr Creyghton, Tucker, Aldrich, Golwin, Weldon, Dr Crofts, Dr Greene, Boyce, and Nares; to whom may be added John Stanley, who attained high proficiency in music, although from two years old totally deprived of sight.

The annals of modern music have hitherto furnished no event so important to the progress of the art as the invention of recitative or dramatic melody; a style of music which resembles the manner of the ancient rhapsodists.

First musical drama.

The *Orfeo* of Politian was the first attempt at musical drama. It was afterwards perfected by Metastasio. No musical dramas similar to those afterwards known

(B) The most celebrated violin players of Italy, from the 16th century to the present time, have been Farina, M. Angelo Rossi, Bassani the violin-master of Corelli, the admirable Angelico Corelli himself, Torelli, Alberti, Albenoni, Tessarini, Vivaldi, Geminiani, one of the most distinguished of Corelli's scholars, Tartini, Veracini, Barbella, Locatelli, Ferrari, Martini, Boccherini, and Giardini.

known by the names of *opera* and *oratorio*, had existence in Italy before the beginning of the 17th century. It was about the 1600, or a little before that time, that eunuchs were first employed for singing in Italy.

First singing eunuchs.

There seem to have been no *singing* eunuchs in ancient times, unless the galli or archigalli, priests of Cybele, were such. Castration has, however, at all times been practised in eastern countries, for the purpose of furnishing to tyrannic jealousy guards of female chastity; but never, so far as modern writers on the subject have discovered, merely to preserve the voice, till about the end of the 16th century.

At Rome, the first public theatre opened for the exhibition of musical dramas, in modern times, was *il Torre de Noua*, where in 1671 Giasone was performed. In 1679, the opera of *Dou è Amore*, set by the famous organist Bernardo Pasquini, was represented at *Nilla Sala de Signori Capranica;* a theatre which still subsists. In the year 1680, *L'Onesta negl' Amore* was exhibited; the first dramatic composition of the elegant, profound, and original Alessandro Scarlatti.

The inhabitants of Venice have cultivated and encouraged the musical drama with more zeal and diligence than the rest of Italy, during the end of the last and beginning of the present century; yet the opera was not established in Venice before the year 1637. In that year the first regular drama was performed. It was Andromeda.

Opera of Berenice.

In 1680 the opera of Berenice was exhibited at Padua with such astonishing splendour as to merit notice. There were choruses of 100 virgins, 100 soldiers, 100 horsemen in iron armour, 40 cornets of horse, 6 trumpeters on horseback, 6 drummers, 6 ensigns, 6 sackbuts, 6 great flutes, 6 minstrels playing on Turkish instruments, 6 others on octave flutes, 6 pages, 3 sergeants, 6 cymbalists. There were 12 huntsmen, 12 grooms, 6 coachmen for the triumph; 6 others for the procession; 2 lions led by two Turks, 2 elephants by two others, Bereniee's triumphal car drawn by 4 horses, 6 other cars with prisoners and spoils drawn by 12 horses, 6 coaches. Among the scenes and representations in the first act were, a vast plain with two triumphal arches, another plain with pavilions and tents, and a forest for the chase. In act third, the royal dressing room completely furnished, stables with 100 live horses, portico adorned with tapestry, and a stupendous palace in perspective. At the end of the first act were representations of every kind of chase, wild boar, stag, deer, bears. At the end of the third act, an enormous globe, descending as from the sky, divided itself into other globes suspended in the air, and ornamented with emblematical figures of time, fame, honour, &c.

Early in the last century, machinery and decoration usurped the importance due to poetry and music in such exhibitions.

Few instances occur of musical dramas at Naples till the beginning of the present century. Before the time of the elder Scarlatti, it seems as if Naples had been less fertile in great contrapuntists, and less diligent in the cultivation of dramatic music, than any other state of Italy. Since that time all the rest of Europe has been furnished with composers and performers from that city.

French and English opera.

The word *opera* seems to have been familiar to English poets from the beginning of the last century. *Stilo recitativo*, a recent innovation even in Italy, is mentioned by Ben Johnson so early as 1617. From this time it was used in masques, occasionally in plays, and in cantatas, before a regular drama wholly set to music was attempted. By the united abilities of Quinault and Lulli, the opera in France had risen to high favour. This circumstance afforded encouragement to several attempts at dramatic music in England by Sir William D'Avenant and others, before the music, language, or performers of Italy were employed on our stage. Pieces, styled *dramatic operas*, preceded the Italian opera on the stage of England. These were written in English, and exhibited with a profuse decoration of scenery and habits, and with the best singers and dancers that could be procured: Psyche and Circe are entertainments of this kind: The Tempest and Macbeth were acted with the same accompaniments.

During the 17th century, whatever attempts were made in musical drama, the language sung was always English. About the end of that century, however, Italian singing began to be encouraged, and vocal as well as instrumental musicians from that country began to appear in London.

The first musical drama, performed wholly after the Italian manner in recitative for the dialogue or narrative parts, and measured melody for the airs, was Arsinoé Queen of Cyprus, translated from an Italian opera of the same name, written by Stanzani of Bologna. The English version of this opera was set to music by Thomas Clayton, one of the royal band, in the reign of William and Mary. The singers were all English, Messrs Hughes, Leveredge, and Cook; Mrs Tofts, Mrs Cross, and Mrs Lyndsey. The translation of Arsinoé, and the music to which it is set, are execrable; yet such is the charm of novelty, that this miserable performance, deserving neither the name of a drama by its poetry, nor of an opera by its music, sustained 24 representations, and the second year 11.

Operas, notwithstanding their deficiencies in poetry, music and performance (no foreign composer or eminent singer having yet arrived), became so formidable to our actors at the theatres, that it appears from the Daily Courant, 14th January 1707, a subscription was opened "for the encouragement of the comedians acting in the Haymarket, and to enable them to keep the diversion of plays under a separate interest from operas."

Mr Addison's opera of Rosamond appeared about this time; but the music set by Clayton is so contemptible, that the merit of the poetry, however great, could not of itself long support the piece. The choice of so mean a composer as Clayton, and Mr Addison's partiality to his abilities, betray a want of musical taste in that elegant author.

The first truly great singer who appeared on the stage of Britain was *Cavalier Nicolino Grimaldi*, commonly known by the name of *Nicolini*. He was a Neapolitan; and though a beautiful singer indeed, was still more eminent as an actor. In the Tatler, N° 115. the elegance and propriety of his action are particularly described*. Recently before his appearance, *Valentini Urbani*, and a female singer called *The Baroness*,

* See also *Spectator*, vol. 1, No. 13.

Baroness, arrived. Margarita de l'Epini, who afterwards married Dr Pepusch, had been in this country some time before.

The first opera performed *wholly in Italian*, and *by Italian singers*, was *Almahide*. As at present so at that time, operas were generally performed twice a week.

Arrival of Handel in England.

The year 1710 is distinguished in the annals of music by the arrival in Britain of George Frederic Handel. Handel had been in the service of the elector of Hanover, and came first to England on a visit of curiosity. The fame of this great musician had penetrated into this country before he himself arrived in it; and Aaron Hill, then in the direction of the Haymarket theatre, instantly applied to him to compose an opera. It was Rinaldo; the admirable music of which he produced entirely in a fortnight. Soon after this period appeared, for the first time as an opera singer, the celebrated Mrs Anastasia Robinson. Mrs Robinson, who was the daughter of a portrait painter, made her first public exhibitions in the concerts at York-buildings; and acquired so much the public favour, that her father was encouraged to take a house in Golden Square, for the purpose of establishing weekly concerts and assemblies, in the manner of *Conversazioni*, which became the resort of the most polite audiences.

Soon after Mrs Robinson accepted an engagement at the Opera, where her salary is said to have been 1000l. and her other emoluments equal to that sum. She quitted the stage in consequence of her marriage with the gallant earl of Peterborough, the friend of Pope and Swift. The eminent virtues and accomplishments of this lady, who died at the age of 88, entitled her to be mentioned even in a compend too short for biography.

The conducting the opera having been found to be more expensive than profitable, it was entirely suspended from 1717 till 1720, when a fund of 50,000l. for supporting and carrying it on was subscribed by the first personages of the kingdom. The subscribers, of whom King George I. was one for 1000l. were formed into a society, and named *The Royal Academy of Music*. Handel was commissioned to engage the performers: For that purpose he went to Dresden, where Italian operas were at that time performed in the most splendid manner at the court of Augustus elector of Saxony, then king of Poland. Here Handel engaged Senesino-Berenstadt, Bosehi, and the Duranstanti.

Progress of the opera under his management.

In the 1723, the celebrated Franeesca Cuzzoni appeared as a first rate singer; and two years afterwards arrived her distinguished rival Signora Faustina Bordoni.

In a cantabile air, though the notes Cuzzoni added were few, she never lost an opportunity of enriching the cantilena with the most beautiful embellishments. Her shake was perfect. She possessed a creative fancy; and she enjoyed the power of occasionally accelerating and retarding the measure in the most artificial and able manner, by what is in Italy called *tempo rubato*. Her high notes were unrivalled in clearness and sweetness. Her intonations were so just and so fixed, that it seemed as if she had not the power to sing out of tune.

Faustina Bordoni, wife of the celebrated Saxon composer Hasse, invented a new kind of singing, by running divisions, with a neatness and velocity which astonished all who heard her. By taking her breath imperceptibly, she had the art of sustaining a note apparently longer than any other singer. Her beats and trills were strong and rapid; her intonation perfect. Her professional perfections were enhanced by a beautiful face, fine symmetry of figure, and a countenance and gesture on the stage which indicated an entire intelligence and possession of the several parts allotted to her.

These two angelic performers excited so signally the attention of the public, that a party spirit between the abettors of the one and of the other was formed, as violent and as inveterate almost as any of those that had ever occurred relative to matters either theological or political; yet so distinct were their styles of singing, so different their talents, that the praise of the one was no reproach to the other.

In less than seven years, the whole 50,000l. subscribed by the Royal Academy, besides the produce of admission to non-subscribers, was expended, and the governor and directors of the society relinquished the idea of continuing their engagements; consequently, at the close of the season 1727, the whole band of singers dispersed. The next year we find Senesino, Faustina, Balde, Cuzzoni, Nicolini, Farinelli, and Bosehe, at Venice.

Handel, however, at his own risk, after a suspension of about a twelvemonth, determined to recommence the Opera; and accordingly engaged a band of performers entirely new. These were Signior Bernacchi, Signora Merighi, Signora Strada, Signior Anibale Pio Fabri, his wife, Signora Bertoldi, and John Godfrid Reimschneider.

Invention of the oratorio, and its introduction in to England.

The sacred musical drama, or oratorio, was invented early in the 14th century. Every nation in Europe seems first to have had recourse to religious subjects for dramatic exhibitions. The oratorios had been common in Italy during the last century. They had never been *publicly* introduced in England, till Handel, stimulated by the rivalship of other adventurers, exhibited in 1732 his oratorios of Esther, and of Acis and Galatea, the last of which he had composed twelve years before for the duke of Chandos's chapel at Cannons. The most formidable opposition which Handel met with in his conduct of the Italian opera was a new theatre for exhibiting these operas, opened by subscription in Lincoln's-inn Fields, under the conduct of Nicola Porpora, a respectable composer. A difference having occurred between Handel and Senesino; Senesino had for some time deserted the Haymarket, where Handel managed, and was now engaged at the rival theatre of Lincoln's-inn Fields. To supply the place of Senesino, Handel brought over *Giovanni Carestini*, a singer of the most extensive powers. His voice was at first a powerful and clear soprano: Afterwards it changed into the fullest, finest, deepest counter-tenor that has perhaps ever been heard. Carestini's person was tall, beautiful, and majestic. He rendered every thing he sung interesting by energy, taste, and judicious embellishment. In the execution of difficult divisions from the chest, his manner was articulate and admirable. It was the opinion of Hasse, as well as other eminent professors,

that whoever had not heard Carestini, was unacquainted with the most perfect style of singing. The opera under the direction of Porpora was removed to the Haymarket, which Handel had left. Handel occupied the theatre of Lincoln's-inn Fields; but his rivals now acquired a vast advantage of attraction, by the accession of Carlo Broschi detto Farinelli to their part, who at this time arrived. This renowned singer seems to have transcended the limit of all anterior vocal excellence. No vocal performer of the present century has been so unanimously allowed to possess an uncommon power, sweetness, extent, and agility of voice, as Farinelli. Nicolini, Senesino, and Carestini, gratified the eye as much by the dignity, grace, and propriety of their action and deportment, as the ear, by the judicious use of a few notes within the limits of a small compass of voice; but Farinelli, without the assistance of significant gestures or graceful attitudes, enchanted and astonished his hearers, by the force, extent, and mellifluous tones of the mere organ, when he had nothing to execute, articulate, or express. Though during the time of singing he was as motionless as a statue, his voice was so active that no intervals were too close, too wide, or too rapid, for his execution.

Handel having lost a great part of his fortune by the opera, was under the necessity of trying the public gratitude in a benefit, which was not disgraced by the event. The theatre, for the honour of the nation, was so crowded, that he is said to have cleared 800l.

Opera in England given up.

After a fruitless attempt by Heidegger, the coadjutor of Handel in the conduct of the opera, and patentee of the King's Theatre in Haymarket, to procure a subscription for continuing it, it was found necessary to give up the undertaking.

It was about this time that the statue of Handel was erected in Vauxhall, at the expence of Mr Tyers, proprietor of those gardens.

The next year (1739) Handel carried on oratorios at the Haymarket, as the opera there was suspended. The earl of Middlesex now undertook the troublesome office of *impresario* of the Italian opera. He engaged Revived. the King's theatre, with a band of singers from the continent almost entirely new. Calluppi was his composer. Handel, almost ruined, retired at this time to Ireland, where he remained a considerable time. In 1744 he again attempted oratorios at the King's theatre, which was then, and till 1746, unoccupied by the opera, on account of the rebellion.

The arrival of Giardini in London this year forms a memorable æra in the history of instrumental music of England. His powers on the violin were unequalled. The same year Dr Croza, then manager of the opera, eloped, leaving the performers, and innumerable trades people, his creditors. This incident put an end to operas of all kinds for some time.

This year a comic opera, called *Il Filosofo di Campagna*, composed by Calluppi, was exhibited, which surpassed in musical merit all the comic operas performed in England till the *Bicona Figliula*. Signora Paganini acquired such fame by the airs allotted to her in that piece, that the crowds at her benefit were beyond example. Caps were lost, gowns torn in pieces, and ladies in full dress, without servants or carriages, were obliged to walk home, amidst the merriment of the spectators on the streets.

At this period the arrival of Giovanni Manzoli mark- 1764 and
ed a splendid era in the annals of musical drama, by 1765.
conferring on serious opera a degree of importance to Manzoli.
which it had seldom yet arisen since its establishment in England. Manzoli's voice was the most powerful and voluminous soprano that had been heard since the time of Farinelli: His manner of singing was grand, and full of taste and dignity.

At this time Tenducci, who had been in England Tenducci.
some time before, and was now returned much improved, performed in the station of second man to Manzoli.

Gaetano Guadagni made a great figure at this time. 1769.
He had been in this country early in life (1748), as Guadagni.
serious man in a burletta troop of singers. His voice was then a full and well-toned counter tenor; but he sung wildly and carelessly. The excellence of his voice, however, attracted the notice of Handel, who assigned him the parts in his oratorios, the Messiah and Samson, which had been originally composed for Mrs Cibber. He quitted London for the first time about 1753. The highest expectations of his abilities were raised by fame before his second arrival, at the time of which we treat. As an actor he seems to have had no equal on any stage in Europe. His figure was uncommonly elegant and noble; his countenance replete with beauty, intelligence, and dignity; his attitudes were full of grace and propriety. Those who remembered his voice when formerly in England were now disappointed: It was comparatively thin and feeble: He had now changed it to a soprano, and extended its compass from six or seven notes to fourteen or fifteen. The music he sung was the most simple imaginable; a few notes with frequent pauses, and opportunities of being liberated from the composer and the band, were all he required. In these effusions, seemingly extemporaneous, he displayed the native power of melody unaided by harmony or even by unisonous accompaniment: The pleasure he communicated proceeded principally from his artful manner of diminishing the tones of his voice, like the dying notes of the Æolian harp. Most other singers affect a swell, or *messa de voce;* but Guadagni, after beginning a note with force, attenuated it so delicately that it possessed all the effect of extreme distance. During the season 1770 and 1771, Tenducci was the immediate successor of Guadagni. This performer, who appeared in England first only as a singer of the second or third class, was during his residence in Scotland and Ireland so much improved as to be well received as first man, not only on the stage of London, but in all the great theatres of Italy.

It was during this period that dancing seemed first to gain the ascendant over music by the superior talents of Mademoiselle Heinel, whose grace and execution were so perfect as to eclipse all other excellence.

In the first opera performed this season (*Lucio Vero*) 1773.
appeared Miss Cecilia Davies, known in Italy by the Miss Davies.
name of L'Inglesina. Miss Davies had the honour of being the first English woman who had ever been thought worthy of singing on any stage in Italy. She even performed with eclat the principal female characters on many of the great theatres of that country.

Gabrielli only on the Continent was said to surpass her. Her voice, though not of great volume, was clear and perfectly in tune; her shake was open and distinct, without the sluggishness of the French cadence. The flexibility of her throat rendered her execution equal to the most rapid divisions.

Next season introduced Venanzio Ravygini, a beautiful and animated young man; a composer as well as a singer.—His voice was sweet, clear, flexible; in compass more than two octaves.

Caterina Gabrielli.

The season 1775 and 1776 was rendered memorable by the arrival of the celebrated *Caterina Gabrielli*, styled early in life *La Cuochetina*, being the daughter of a cardinal's cook at Rome. She had, however, in her countenance and deportment no indications of low birth. Her manner and appearance depicted dignity and grace. So great was her reputation before her arrival in England for singing and for caprice, that the public, expecting perhaps in both too much, were unwilling to allow her due praise for her performance, and were apt to ascribe every thing she did to pride and insolence. Her voice, though exquisite, was not very powerful. Her chief excellence having been the neatness and rapidity of her execution, the surprise of the public must have been much diminished on hearing her after Miss Davies, who sung many of the same songs in the same style, and with a neatness so nearly equal, that common hearers could distinguish no difference. The discriminating critic, however, might have discovered a superior sweetness in the natural tone of Gabrielli's voice, an elegance in the finishing of her musical periods or passages, an accent and precision in her divisions, superior not only to Miss Davies, but to every other singer of her time. In slow movements her pathetic powers, like those in general of performers most renowned for agility, were not exquisitely touching.

Agujari at the Pantheon.

About the time of which we have been treating, the proprietors of the Pantheon ventured to engage *Agujari* at the enormous salary of 100l. per night, for singing two songs only: *Lucrezia Agujari* was a truly wonderful performer. The lower part of her voice was full, round, and of excellent quality; its compass amazing. She had two octaves of fair natural voice, from A on the fifth line in the base to A on the sixth line in the treble, and beyond that *in alt* she had in early youth more than another octave. She has been heard to ascend to B b *in altissimo*. Her shake was open and perfect: her intonation true; her execution marked and rapid; the style of her singing, in the natural compass of her voice, grand and majestic.

Anna Pozzi.

In 1776 arrived Anna Pozzi, as successor to Gabrielli. She possessed a voice clear, sweet, and powerful; but her inexperience, both as an actress and as a singer, produced a contrast very unfavourable to her when compared with so celebrated a performer as Gabrielli. After that time, however, Pozzi, with more study and knowledge, became one of the best and most admired female singers in Italy.

Georgi.

After the departure of Ajugari for the second and last time, the managers of the Pantheon engaged *Georgi* as her successor. Her voice was exquisitely fine, but totally uncultivated. She was thereafter employed as the first woman in the operas of the principal cities of Italy.

Roncaglia and Danze.

During the seasons 1777 and 1778 the principal singers at the opera in London were Francesco Roncaglia and Francesca Danze, afterwards Madame Le Brun.

Roncaglia possessed a sweet toned voice; but of the three great requisites of a complete stage singer, pathos, grace, and execution, which the Italians call *cantabile*, *graziosa*, and *bravura*, he could lay claim only to the second. His voice, a *voce de camera*, when confined to the *graziosa* in a room, left nothing to wish for.

Danze had a voice well in tune, a good shake, great execution, prodigious compass, with great knowledge of music; yet the pleasure her performance imparted was not equal to these accomplishments. But her object was not so much pathos and grace, as to surprise by the imitation of the tone and difficulties of instruments.

Pacchierotti.

This year *Gasparo Pacchierotti* appeared in London, whither his high reputation had penetrated long before. The natural tone of his voice was interesting, sweet, and pathetic. His compass downwards was great, with an ascent up to B b, and sometimes to C *in alt*. He possessed an unbounded fancy, and the power not only of executing the most difficult and refined passages, but of inventing embellishment entirely new. *Ferdinando Bertoni*, a well known composer, came along with Pacchierotti to Britain.

Dancing gains the ascendant over music at the opera house.

About this time dancing became an important branch of the amusements of the opera house. Mademoiselle Heinel, M. Vestris le Jeune, Mademoiselle Baccelli, had, during some years, delighted the audience at the opera; but on the arrival of M. Vestris l'Ainè, pleasure was exchanged for ecstasy. In the year 1781, Pacchierotti had by this time been so frequently heard, that his singing was no impediment to conversation; but while the elder Vestris was on the stage, not a breathing was to be heard. Those lovers of music who talked the loudest while Pacchierotti sung, were in agonies of terror lest the graceful movements of Vestris, *le dieu de la danse*, should be disturbed by audible approbation. After that time, the most mute and respectful attention was paid to the manly grace of Le Picq, and the light fantastic toe of the younger Vestris; to the Rossis, the Theodores, the Coulons, the Hillingsburgs; while the slighted singers were disturbed, not by the violence of applause, but the clamour of inattention.

Commemoration of Handel in Westminster Abbey.

The year 1784 was rendered a memorable era in the annals of music by the splendid and magnificent manner in which the birth and genius of Handel were celebrated in Westminster Abbey and the Pantheon, by five performances of pieces selected from his own works, and executed by a band of more than 500 voices and instruments, in the presence and under the immediate auspices of their majesties and the first personages of the kingdom. The commemoration of Handel has been since established as an annual musical festival for charitable purposes; in which the number of performers and the perfection of the performances have continued to increase. In 1785 the band, vocal and instrumental, amounted to 616: in 1786 to 741; in 1787 to 806; and in subsequent years to still greater numbers.

Dr Burney published An Account of the Musical Performances in Commemoration of Handel, for the benefit

benefit of the Musical Fund. The members and guardians of that fund are now incorporated under the title of *Royal Society of Musicians*. See HANDEL.

This year Pacchierotti and his friend Bertoni left England. About the same time our country was deprived of the eminent composer Sacchini, and Giardini the greatest performer on the violin now in Europe.

Excellence of Madame Mara.

As a compensation for these losses, this memorable year is distinguished by the arrival of Madame Mara, whose performance in the commemoration of Handel in Westminster Abbey inspired an audience of 3000 of the first people of the kingdom, not only with pleasure but with ecstacy and rapture.

Rubinelli.

In 1786 arrived *Giovanni Rubinelli*. His voice was a true and full contr'alto from C in the middle of the scale to the octave above. His style was grand; his execution neat and distinct; his taste and embellishments new, select, and masterly.

A new dance by M. Noverre.

In 1788 a new dance, composed by the celebrated M. Noverre, called *Cupid and Psyche*, was exhibited along with the opera *La Locandiera*, which produced an effect so uncommon as to deserve notice. So great was the pleasure it afforded to the spectators, that Noverre was unanimously brought on the stage and crowned with laurel by the principal performers. This, though common in France, was a new mark of approbation in England.

Marchesi.

This year arrived Signior Luige Marchesi, a singer whose talents have been the subject of praise and admiration on every great theatre of Europe. Marchesi's style of singing was not only elegant and refined in an uncommon degree, but often grand and full of dignity, particularly in his recitative and occasional low notes. His variety of embellishment and facility of running extempore divisions were wonderful. Many of his graces were elégant and of his own invention.

Discriminated characters of Pacchierotti, Rubinelli, and Marchesi.

The three greatest Italian singers of these times were certainly Pacchierotti, Rubinelli, and Marchesi. In discriminating the several excellencies of these great performers, a very respectable judge, Dr Burney, has particularly praised the sweet and touching voice of Pacchierotti; his fine shake, his exquisite taste, his great fancy, and his divine expression in pathetic songs: Of Rubinelli's voice, the fulness, steadiness, and majesty, the accuracy of his intonations, his judicious graces: Of Marchesi's voice, the elegance and flexibility, his grandeur in recitative, and his boundless fancy and embellishments.—Having mentioned Dr Burney, we are in justice bound to acknowledge the aid we have derived from his history; a work which we greatly prefer to every other modern production on the subject.

During the latter part of the 18th century many eminent composers flourished on the continent; such as Jomelli, the family of the Bachs, Gluck, Haydn, and many others, whose different styles and excellencies would well deserve to be particularized, would our limits permit. With the same regard to brevity, we can do no more than just mention the late king of Prussia, the late elector of Bavaria, and Prince Lobkowitz, as eminent dilettanti of modern times.

Sovereign princes dilettanti.

Singers on theatres and in public gardens.

Besides the opera singers whom we have mentioned, our theatres and public gardens have exhibited singers of considerable merit. In 1730 Miss Raftor, afterwards the celebrated Mrs Clive, first appeared on the stage at Drury-lane as a singer. The same year introduced Miss Cecilia Young, afterwards the wife of Dr Arne. Her style of singing was infinitely superior to that of any other English woman of her time.

Favourite musicians.

Our favourite musicians at this time were, Dubourg, Clegg, Clarke, and Festing, on the violin; Kytch on the hautboy; Jack Festing on the German flute; Baston on the common flute; Karba on the bassoon; Valentine Snow on the trumpet: and on the organ, Roseingrave, Green, Robinson, Magnus, Jack James, and the blind Stanley, who seems to have been preferred. The favourite playhouse singer was Salway; and at concerts Mountier of Chichester.

As composers for our national theatre, Pepusch and Galliard seem to have been unrivalled till 1732; when two competitors appeared, who were long in possession of the public favour: We allude to John Frederick Lampe and Thomas Augustus Arne.

In 1736 Mrs Cibber, who had captivated every hearer of sensibility by her native sweetness of voice and powers of expression as a singer, made her first attempt as a tragic actress. The same year Beard became a favourite singer at Covent-garden. At this time Miss Young, afterwards Mrs Arne, and her two sisters Isabella and Esther, were the favourite English female singers.

Fund for decayed musicians.

In 1738 was instituted the fund for the support of decayed musicians and their families.

It was in 1745 that Mr Tyers, proprietor of Vauxhall gardens, first added vocal music to the other entertainments of that place. A short time before Ranelagh had become a place of public amusement.

Arrival of Giardini.

In 1749 arrived Giardini, whose great taste, hand, and style in playing on the violin, procured him universal admiration. A few years after his arrival he formed a morning *academia* or concert at his house, composed chiefly of his scholars.

About this time San Martini and Charles Avison were eminent composers.

Of near 150 musical pieces brought on our national theatres within 40 years, 38 of them at least were set by Arne. The style of this composer, if analyzed, would perhaps appear to be neither Italian nor English; but an agreeable mixture of both and of Scotch.

Style of Arne.

The late earl of Kelly, who died some years ago, deserves particular notice, as possessed of a very eminent degree of musical science, far superior to other dilettanti, and perhaps not inferior to any professor of his time. There was no part of theoretical or practical music in which he was not thoroughly versed: He possessed a strength of hand on the violin, and a genius for composition, with which few professors are gifted.

The earl of Kelly.

Abel.

Charles Frederick Abel was an admirable musician: His performance on the viol da gamba was in every particular complete and perfect. He had a hand which no difficulties could embarrass; a taste the most refined and delicate; a judgment so correct and certain as never to permit a single note to escape him without meaning. His compositions were easy and elegantly simple. In writing and playing an *adagio* he was superior to all praise; the most pleasing yet learned modulation, the richest harmony, the most elegant and polished melody, were all expressed with the most exquisite feeling, taste, and science. His manner of playing

playing an adagio soon became the model of imitation for all our young performers on bowed instruments. Bartholemon Cervetto, Cramer, and Crosdil, were in this respect to be ranked as of his school. All lovers of music must have lamented that Abel in youth had not attached himself to an instrument more worthy of his genius, taste, and learning, than the viol da gamba, that remnant of the old chest of viols which during the 17th century was a necessary appendage of a nobleman's or gentleman's family throughout Europe, previous to the admission of violins, tenors, and basses, in private houses or public concerts. Since the death of the late elector of Bavaria, who was next to Abel the best performer on the viol da gamba in Europe), the instrument seems quite laid aside. It was used longer in Germany than elsewhere; but the place of gambist seems now as much suppressed in the chapels of German princes as that of lutanist. The celebrated performer on the violin, Lolle, came to England in 1785. Such was his caprice, that he was seldom heard; and so eccentric was his style and composition, that by many he was regarded as a madman. He was, however, during his lucid intervals a very great and expressive performer in the serious style.

Mrs Billington.

Mrs Billington, after distinguishing herself in childhood as a neat and expressive performer on the pianoforte, appeared all at once in 1786 as a sweet and captivating singer. In emulation of Mara and other great bravura singers, she at first too frequently attempted passages of difficulty; afterward, however, so greatly was she improved, that no song seemed too high or too rapid for her execution. Now, at the distance of 20 years, she retains her high reputation. The natural tone of her voice is so exquisitely sweet, her knowledge of music so considerable, her shake so true, her closes and embellishments so various, her expressions so grateful, that envy only or apathy could hear her without delight.

The present composers, and performers of the first class, are so well known to the lovers of the art, that it would be needless and improper to mention them particularly.

The catch-club and the concert of ancient music.

The Catch-club at the Thatched House, instituted in 1762 by the earl of Eglinton, the duke of Queensberry, and others; and the concert of ancient music, suggested by the earl of Sandwich in 1776, have had a beneficial effect in improving the art.

Two female performers have lately appeared of distinguished eminence.

Madame Grassini.

Madame Grassini had exhibited her vocal powers in Paris with extraordinary applause, and arrived in London in 1805, where she excited uncommon admiration. She appeared in Zaira, where the display of her powers not only pleased, but she astonished, when it was considered that the compass of her voice did not exceed eight or ten notes.

Madame Catalani.

The year following Madame Catalani divided the public attention with Grassini.—This eminent performer is a native of Sinigaglia in Italy, where her father was a singer of the comic order.

She was educated in a convent. The virtuous impressions she there received, have continued ever since invariably to influence her conduct.

Her father soon discovered the excellence and the value of her vocal powers, which were first exhibited on the provincial theatres of Italy.—He soon carried her to Spain, where she attained very high celebrity. It was there her husband, M. de Valabregue, first paid his addresses to her; and it was not till after a perseverance of seven months that he at last obtained her consent to unite her fortunes with his. Her hesitation proceeded from the reluctance of her father, at once to be deprived of his daughter, and of the very great emolument which she brought him. M. de Valabregue had been an officer in the French army under General Moreau.

From Spain Madame Catalani (for she has retained her father's name), proceeded to Portugal, where she accepted an engagement to come to London. She travelled through France, and at Paris appeared at an occasional concert, where her fame was so great, that the usual price of admission was trebled. She particularly attracted the attention of the singular man who now holds the imperial sceptre of the continent of Europe. He ordered her a pension (its value is about 30l. per annum); and it was with much difficulty, and only through the interference of the British ambassador (the earl of Lauderdale) then at Paris, that she was permitted to leave that capital, and proceed on her journey.

In the dramatic music of the opera, this singer is far superior to any performer ever heard in this country. Her merit in Semiramide, in particular, presents almost the idea of perfection. Her voice is equal to the most difficult execution, while her countenance is interesting, her gestures graceful, and her person elegant. It has been reported that she does not sing in tune; but it is an undeniable fact, vouched by the first musicians, that she possesses a most accurate ear. Every vocal performer occasionally emits a false sound in consequence of some temporary organic cause.

Catalani's easy and clear articulation are particularly striking, her tones are full and liquid. Her cadences are appropriate and masterly. She has a practice of rapidly descending in half notes, which has excited admiration chiefly by its entire novelty. The clearness and rapidity displayed by her in chromatic passages excite astonishment; and she combines mellowness with distinctness, a high qualification, which Mara first taught us to appreciate. In the course of summer 1807, Madame Catalani visited the provincial theatres of England, and appeared likewise in Dublin, Edinburgh, and Glasgow. Her total receipts for that year are said to have exceeded 15.000l.

We have been somewhat particular in our account of musical affairs in our own country during the 18th century, as what would be most interesting to general readers, and of which a well-informed gentleman would not wish to be ignorant. The professor and connoisseur will have recourse to disquisitions much more minute than those of which our limits can be supposed to admit.

ELEMENTS OF MUSIC,

THEORETICAL AND PRACTICAL (C).

PRELIMINARY DISCOURSE.

Music considered in a double view.

MUSIC may be considered, either as an art, which has for its object one of the greatest pleasures of which our senses (D) are susceptible; or as a science, by which that art is reduced to principles. This is the double view in which we mean to treat of music in this work.

Progress of music like that of other arts and sciences.

It has been the case with music as with all the other arts invented by man; some facts were at first discovered by accident; soon afterwards reflection and observation investigated others: and from these facts, properly disposed and united, philosophers were not slow in forming a body of science, which afterwards increased by degrees.

The first theories of music were perhaps as ancient as the earliest age which we know to have been distinguished by philosophy, even as the age of Pythagoras; nor does history leave us any room to doubt, that from the period when that philosopher taught, the ancients cultivated music, both as an art and as a science, with great assiduity. But there remains to us much uncertainty concerning the degree of perfection to which they brought it. Almost every question which has been proposed with respect to the music of the ancients has divided the learned; and probably may still continue to divide them, for want of monuments sufficient in their number, and incontestable in their nature, from whence we might be enabled to exhibit testimonies and discoveries instead of suppositions and conjectures. In the preceding history we have stated a few facts respecting the nature of ancient music, and the inventors of the several musical instruments; but it were to be wished, that, in order to elucidate, as much as possible, a point so momentous in the history of the sciences, some person of learning, equally skilled in the Greek language and in music, should exert himself to unite and discuss in the same work the most probable opinions established or proposed by the learned, upon a subject so difficult and curious. This philosophical history of ancient music is a work which might highly embellish the literature of our times.

The history of music a desideratum in literature.

In the mean time, till an author can be found sufficiently instructed in the arts and in history to undertake such a labour with success, we shall content ourselves with considering the present state of music, and limit our endeavours to the explication of those accessions which have accrued to the theory of music in these latter times.

There are two departments in music, melody * and harmony †. Melody is the art of arranging several sounds in succession one to another in a manner agreeable to the ear; harmony is the art of pleasing that organ by the union of several sounds which are heard at one and the same time. Melody has been known and felt throughout all ages: perhaps the same cannot be affirmed of harmony (E); we know not whether the ancients made any use of it or not, nor at what period it began to be practised.

* See *Melody.*
† See *Harmony.*

Not but that the ancients certainly employed in their music

(C) To deliver the elementary principles of music, theoretical and practical, in a manner which may prove at once entertaining and instructive, without protracting this article much beyond the limits prescribed in our plan, appears to us no easy task. We therefore hesitated for some time whether to try our own strength, or to follow some eminent author on the same subject. Of these the last seemed preferable. Amongst these authors, none appeared to us to have written any thing so fit for our purpose as M. d'Alembert, whose treatise on music is the most methodical, perspicuous, concise, and elegant dissertation on that subject with which we are acquainted. As it was unknown to most English readers before a former edition of this work, it ought to have all the merit of an original. We have given a translation of it; and in the notes, we have added, from the works of succeeding authors, and from our own observations, such explanations as appeared necessary, to adapt the work to the present day.

(D) In this passage, and in the definitions of melody and harmony, our author seems to have adopted the vulgar error, that the pleasures of music terminate in corporeal sense. He would have pronounced it absurd to assert the same thing of painting. Yet if the former be no more than a mere pleasure of corporeal sense, the latter must likewise be ranked in the same predicament. We acknowledge that corporeal sense is the vehicle of sound; but it is plain from our immediate feelings, that the results of sound arranged according to the principles of melody, or combined and disposed according to the laws of harmony, are the objects of a reflex or internal sense.

For a more satisfactory discussion of this matter, the reader may consult that elegant and judicious treatise on Musical Expression by Mr Avison. In the mean time it may be necessary to add, that, in order to shun the appearance of affectation, we shall use the ordinary terms by which musical sensations, or the mediums by which they are conveyed, are generally denominated.

(E) Though no certainty can be obtained what the ancients understood of harmony, nor in what manner and in what period they practised it; yet it is not without probability, that, both in speculation and practice, they were in possession of what we denominate *counterpoint*. Without supposing this, there are some passages in the Greek authors which can admit of no satisfactory interpretation. See the *Origin and Progress of Language*, vol. ii.

Besides,

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music those chords which were most perfect and simple; such as the octave, the fifth, and the third; but it seems doubtful whether they knew any of the other consonances or not, or even whether in practice they could deduce the same advantages from the simple chords which were known to them, that have afterwards accrued from experience and combinations.

If that harmony which we now practise owes its origin to the experience and reflection of the moderns, there is the highest probability that the first essays of this art, as of all the others, were feeble, and the progress of its efforts almost imperceptible: and that, in the course of time, improving by small gradations the successive labours of several geniuses have elevated it to that degree of perfection in which at present we find it.

The origin of arts often accidental, and their progress gradual.

The first inventor of harmony escapes our investigation, from the same causes which leave us ignorant of those who first invented each particular science; because the original inventors could only advance one step, a succeeding discoverer afterwards made a more sensible improvement, and the first imperfect essays in every kind were lost in the more extensive and striking views to which they led. Thus the arts which we now enjoy, are for the most part far from being due to any particular man, or to any nation exclusively: they are produced by the united and successive endeavours of mankind; they are the results of such continued and united reflections, as have been formed by all men at all periods and in all nations.

It might, however, be wished, that after having ascertained, with as much accuracy as possible, the state of ancient music by the small number of Greek authors which remain to us, the same application were immediately directed to investigate the first incontestable traces of harmony which appear in the succeeding ages, and to pursue those traces from period to period. The products of these researches would doubtless be very imperfect, because the books and monuments of the middle ages are by far too few to enlighten that gloomy and barbarous era; yet these discoveries would still be precious to a philosopher, who delights to observe the human mind in the gradual evolution of its powers, and the progress of its attainments.

Delineations of the laws of harmony recent and imperfect.

The first compositions upon the laws of harmony which we know, are of no higher antiquity than two ages prior to our own; and they were followed by many others. But none of these essays was capable of satisfying the mind concerning the principles of harmony: they confined themselves almost entirely to the single occupation of collecting rules, without endeavouring to account for them; neither had their analogies one with another, nor their common source, been perceived; a blind and unenlightened experience was the only compass by which the artist could direct and regulate his course.

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M. Rameau was the first who began to transfuse light and order through this chaos. In the different tones produced by the same sure sonorous body, he found the most probable original harmony, and the cause of that pleasure which we receive from it. His principle he unfolded, and showed how the different phenomena of music were produced by it: he reduced all the consonances to a small number of simple and fundamental chords, of which the others are only combinations or various arrangements. He has, in short, been able to discover, and render sensible to others, the mutual dependence between melody and harmony.

Its precepts not deduced from any principle till by M. Rameau.

The author's motives for writing these elements.

Though these different topics may be contained in the writings of this celebrated artist, and in these writings may be understood by philosophers who are likewise adepts in the art of music; still, however, such musicians as were not philosophers, and such philosophers as were not musicians, have long desired to see these objects brought more within the reach of their capacity. Such is the intention of the present treatise; in which we claim no other merit than that of having developed, elucidated, and perhaps in some respects improved, the ideas of another (F).

Improvements of this edition.

Account of the work in general.

The first edition of this essay, published in 1752, having been favourably received, we have endeavoured to render this more perfect. The detail which is meant to be given of my labour, will present the reader with a general idea of the principle of M. Rameau, of the consequences deduced from it, of the manner in which I have disposed this principle and its consequences; in short, of what is still wanting, and might be advantageous to the theory of this delightful art; of what still remains for the learned to contribute towards the perfection of this theory; of the rocks and quicksands which they ought to avoid in this research, and which could serve no other purpose than to retard their progress.

Rameau's origin of harmony.

Every sonorous body, besides its principal sound, likewise exhibits to the ear the 12th and 17th major of that sound. This multiplicity of different yet concordant sounds, known for a considerable time, constitutes the basis of the whole theory of M. Rameau, and the foundation upon which he builds the whole superstructure of a musical system*. In these our *elements* may be seen, how from this experiment one may deduce, by an easy operation of reason, the chief points of melody and harmony; the perfect † chord, as well major as minor; the two ‡ tetrachords employed in ancient music; the formation of our diatonic || scale; the different values § which the same sound may have in that scale, according to the turn which is given to the bass ¶; the alterations * which we observe in that scale, and the reason why they are totally imperceptible to the ear; the rules peculiar to the mode † major; the difficulty in ‡ intonation of forming three tones || in succession; the reason why two perfect chords are proscribed

* See *System.*
† See *Chord.*
‡ See *Tetrachord.*
|| See *Diatonic.*
§ See *Value.*
¶ See *Bass.*
* See *Alteration.*
† See *Mode.*
‡ See *Intonation.*
|| See *Tone*

Besides, we can discover some vestiges of harmony, however rude and imperfect, in the history of the Gothic ages, and amongst the most barbarous people. This they could not have derived from more cultivated countries, because it appears to be incorporated with their national music. The most rational account, therefore, which can be given, seems to be, that it was conveyed in a mechanical or traditionary manner through the Roman provinces from a more remote period of antiquity.

(F) See M. Rameau's letter upon this subject, *Merc. de Mai*, 1752.

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scribed in immediate succession in the diatonic order; the origin of the minor mode, its subordination to the mode major, and its variations; the use of discord §; the causes of such effects as are produced by different kinds of music, whether diatonic, chromatic *, or enharmonic †; the principles and laws of temperament ‡. In this discourse we can only point out those different objects, the subsequent essay being designed to explain them with the minuteness and precision which they require.

§ See *Discord.*
* See *Chromatic.*
† See *Enharmonic.*
‡ See *Temperament.*

One end which we have proposed in this treatise, was not only to elucidate, but to simplify the discoveries of M. Rameau.—For instance, besides the fundamental experiment mentioned above, that celebrated musician, to facilitate the explication of certain phenomena, had recourse to another experiment; that which shows that a sonorous body struck and put in vibration, forces its 12th and 17th major in descending to divide themselves and produce a tremulous sound. The chief use which M. Rameau made of this second experiment was to investigate the origin of the minor mode, and to account for some other rules established in harmony; but we have found means to deduce from the first experiment alone the formation of the minor mode, and, besides, to disengage that formation from all questions foreign to it.

In some other points also; (as, the origin of the chord of the sub-dominant *, and the explication of the seventh in certain cases) it is imagined that we have simplified, and perhaps in some measure extended the principles of the celebrated artist.

* See *Sub-dominant.*

We have likewise banished every consideration of geometrical, arithmetical, and harmonical proportions and progressions, which have been sought in the mixture and protraction of tones produced by a sonorous body; persuaded as we are, that M. Rameau was under no necessity of paying the least regard to these proportions, which we believe to be not only useless, but even, if we may venture to say so, fallacious when applied to the theory of music. In short, though the relations produced by the octave, the fifth, and the third, &c. were quite different from what they are; though in these chords we should neither remark any progression nor any law; though they should be incommensurable one with another; the protracted tone of the sonorous body, and the multiplied sounds which result from it, are a sufficient foundation for the whole harmonic system.

Theoretical musicians cautioned with regard to the admission of mathematical or metaphysical principles in music.

But though this work is intended to explain the theory of music, and to reduce it to a system more complete and more luminous than has hitherto been done, we ought to caution our readers against misapprehension either of the nature of our subject or of the purpose of our endeavours.

We must not here look for that striking evidence which is peculiar to geometrical discoveries alone, and which can be so rarely obtained in these mixed disquisitions, where natural philosophy is likewise concerned. Into the theory of musical phenomena there must always enter a particular kind of metaphysics, which these phenomena implicitly take for granted, and which brings along with it its natural obscurity. In this subject, therefore, it would be in vain to expect what is called *demonstration*: it is much to have reduced the principal facts to a consistent and connected system; to have deduced them from one simple experiment; and to have established upon this foundation the most common and essential rules of the musical art. But if the intimate and unalterable conviction which can only be produced by the strongest evidence is not here to be required, we must also doubt whether a clearer elucidation of our subject be possible.

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After this declaration, it will not excite surprise, that, amongst the facts deduced from our fundamental experiment, some should immediately appear to depend upon that experiment, and others to result from it in a way more remote and less direct. In disquisitions of natural philosophy, where we are scarcely allowed to use any other arguments than those which arise from analogy or congruity, it is natural that the analogy should be sometimes more and sometimes less sensible; and we will venture to pronounce that mind very unphilosophical, which cannot recognise and distinguish this gradation and the different circumstances on which it proceeds. It is not even surprising, that, in a subject where analogy alone can take place, this conductress should desert us all at once in our attempts to account for certain phenomena. This likewise happens in the subject which we now treat; nor do we conceal the fact, however mortifying, that there are certain points (though their number be but small) which appear still in some degree unaccountable from our principle. Such, for instance, is the procedure of the diatonic scale of the minor mode in descending, the formation of the chord commonly termed the *sixth redundant* † or *superfluous*, and some other facts of less importance, for which as yet we can scarcely offer any satisfactory account except from experience alone.

† See *Redundant.*

Thus, though the greatest number of the phenomena of music appear to be deducible in a simple and easy manner from the protracted tone of sonorous bodies, it ought not perhaps with too much temerity to be affirmed as yet that this mixed and protracted tone is *demonstratively* the only original principle of harmony. But in the mean time it would not be less unjust to reject this principle, because certain phenomena appear to be deduced from it with less success than others. It is only necessary to conclude from this, either that by future scrutinies means may be found for reducing these phenomena to this principle; or that harmony has perhaps some other unknown principle, more general than that which results from the protracted and compounded tone of sonorous bodies, and of which this is only a branch; or, lastly, that we ought not perhaps to attempt the reduction of the whole science of music to one and the same principle; which, however, is the natural effect of an impatience so frequent even among philosophers themselves, which induces them to take a part for the whole, and to judge of objects in their full extent by the greatest number of their appearances.

Rameau's primary experiment has not as yet accounted for all the phenomena of music. Perhaps some other may be necessary.

In those sciences which are called *physico-mathematical* (and amongst this number perhaps the science of sounds may be placed), there are some phenomena which depend only upon one single principle and one single experiment: there are others which necessarily suppose a greater number both of experiments and principles, whose combination is indispensable in forming an exact and complete system; and music perhaps is in this last case. It is for this reason, that whilst we

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we bestow on M. Rameau all due praise, we should not at the same time neglect to stimulate the learned in their endeavours to carry them still to higher degrees of perfection, by adding, if it is possible, such improvements as may be wanting to consummate the science.

Whatever the result of their efforts may be, the reputation of this intelligent artist has nothing to fear: he will still have the advantage of being the first who rendered music a science worthy of philosophical attention; of having made the practice of it more simple and easy; and of having taught musicians to employ in this subject the light of reason and analogy.

We would the more willingly persuade those who are skilled in theory and eminent in practice to extend and improve the views of him who before them pursued and pointed out the career, because many amongst them have already made laudable attempts, and have even been in some measure successful in diffusing new light through the theory of this enchanting art. It was with this view that the celebrated Tartini has presented us in 1754 with a treatise of harmony, founded on a principle different from that of M. Rameau. This principle is the result of a most beautiful experiment (G). If at once two different sounds are produced from two instruments of the same kind, these two sounds generate* a third different from both the others. We have inserted in the *Encyclopédie*, under the article *Fundamental*, a detail of this experiment according to M. Martini; and we owe to the public an information, of which in composing this article we were ignorant: M. Romieu, a member of the Royal Society at Montpelier, had presented to that society in the year 1753, before the work of M. Tartini had appeared, a memorial printed the same year, and where may be found the same experiment displayed at full length. In relating this fact, which it was necessary for us to do, it is by no means our intention to detract in any degree from the reputation of M. Tartini; we are persuaded that he owes this discovery to his own researches alone: but we think ourselves obliged in honour to give public testimony in favour of him who was the first in exhibiting this discovery.

Tartini's experiments.

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* See *Generate.*

Its discovery originally due to Romieu.

But whatever be the case, it is in this experiment that M. Tartini attempts to find the origin of harmony: his book, however, is written in a manner so obscure, that it is impossible for us to form any judgement of it; and we are told that others distinguished for their knowledge of the science are of the same opinion. It were to be wished that the author would engage some man of letters, equally practised in music and skilled in the art of writing, to unfold these ideas which

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(G) Had the utility of the preliminary discourse in which we are now engaged been less important and obvious than it really is, we should not have given ourselves the trouble of translating, or our readers that of perusing it. But it must be evident to every one, that the cautions here given, and the advices offered, are no less applicable to students than to authors. The first question here decided is, Whether pure mathematics can be successfully applied to the theory of music? The author is justly of a contrary opinion. It may certainly be doubted with great justice, whether the solid contents of sonorous bodies, and their degrees of cohesion or elasticity, can be ascertained with sufficient accuracy to render them the subjects of musical speculation, and to determine their effects with such precision as may render the conclusions deduced from them geometrically true. It is admitted, that sound is a secondary quality of matter, and that secondary qualities have no obvious connexion which we can trace with the sensations produced by them. Experience, therefore, and not speculation, is the grand criterion of musical phenomena. For the effects of geometry in illustrating the theory of music (if any will still be so credulous as to pay them much attention), the English reader may consult Smith's Harmonics, Malcolm's Dissertation on Music, and Pleydel's Treatise on the same subject inserted in a former edition of this work. Our author next treats of the famous discovery made by Signor Tartini, of which the reader may accept the following compendious account.

If two sounds be produced at the same time properly tuned and with due force, from their conjunction a third sound is generated, so much more distinctly to be perceived by delicate ears as the relation between the generating sounds is more simple; yet from this rule we must except the unison and octave. From the fifth is produced a sound unison with its lowest generator; from the fourth, one which is an octave lower than the highest of its generators; from the third major, one which is an octave lower than its lowest; and from the sixth minor (whose highest note forms an octave with the lowest in the third formerly mentioned) will be produced a sound lower by a double octave than the highest of the lesser sixth; from the third minor, one which is double the distance of a greater third from its lowest; but from the sixth major (whose highest note makes an octave to the lowest in the third minor) will be produced a sound only lower by double the quantity of a greater third than the highest; from the second major, a sound lower by a double octave than the lowest; from a second minor, a sound lower by triple the quantity of a third major than the highest; from the interval of a diatonic or greater semitone, a sound lower by a triple octave than the highest; from that of a minor or chromatic semitone, a sound lower by the quantity of a fifth four times multiplied than the lowest, &c. &c. But that these musical phenomena may be tried by experiments proper to ascertain them, two hautboys tuned with scrupulous exactness must be procured, whilst the musicians are placed at the distance of some paces one from the other, and the hearers in the middle. The violin will likewise give the same chords, but they will be less distinctly perceived, and the experiment more fallacious, because the vibrations of other strings may be supposed to enter into it.

If our English reader should be curious to examine these experiments and the deductions made from them in the theory of music, he will find them clearly explained and illustrated in a treatise called *Principles and Power of Harmony*, printed at London in the year 1771.

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which he has not communicated with sufficient perspicuity, and from whence the art might perhaps derive considerable advantage if they were placed in a proper light. Of this we are so much the more persuaded, that even though this experiment should not be regarded by others in the same view with M. Tartini as the foundation of the musical art, it is nevertheless extremely probable that one might use it with the greatest advantage to enlighten and facilitate the practice of harmony.

In exhorting philosophers and artists to make new attempts for the advancement of the theory of music, we ought at the same time to caution them against mistaking the real end of their researches. Experience is the only foundation upon which they can proceed; it is alone by the observation of facts, by bringing them together in one view, by showing their dependency upon one, if possible, or at least upon a very small number of primary facts, that they can reach the end to which they so ardently aspire, the important end of establishing a theory of music, at once great, complete and luminous. The enlightened philosopher will not attempt the explanation of facts, because he knows how little such explanations are to be relied on. To estimate them according to their proper value, it is only necessary to consider the attempts of natural philosophers who have discovered the greatest skill in their science, to explain, for instance, the multiplicity of tones produced by sonorous bodies. Some having remarked (what is by no means difficult to conclude) that the universal vibration of a musical string is a mixture of several partial vibrations, infer that a sonorous body ought to produce a multiplicity of tones, as it really does. But why should this multiplied sound only appear to contain three, and why these three preferable to others? Others pretend that there are particles in the air, which, by their different degrees of tension, being naturally susceptible of different oscillations, produce the multiplicity of sound in question. But what do we know of all this? And though it should even be granted, that there is such a diversity of tension in these aerial particles, how should this diversity prevent them from being all of them confounded in their vibrations by the motions of a sonorous body? What then should be the result when the vibrations arrive at our ears, but a confused and inappretiable * noise, where one could not distinguish any particular sound?

Mechanical conclusions inadequate to the situation of musical phenomena.

* See *Inappretiable.*

If philosophical musicians ought not to lose their time in searching for mechanical explications of the phenomena in music, explications which will always be fond vague and unsatisfactory; much less is it their province to exhaust their powers in vain attempts to rise above their sphere into a region still more remote from the prospect of their faculties, and to lose themselves in a labyrinth of metaphysical speculations upon the causes of that pleasure which we feel from harmony. In vain would they accumulate hypothesis on hypothesis, to find a reason why some chords should please us more than others. The futility of these suppositious accounts must be obvious to every one who has the least penetration. Let us judge of the rest by the most probable which has till now been invented for that purpose. Some ascribe the different degrees of pleasure which we feel from chords, to the more or less frequent coincidence of vibrations; others to the relations which these vibrations have among themselves as they are more or less simple. But why should this coincidence of vibrations, that is to say, their simultaneous impulse on the same organs of sensation, and the accident of beginning frequently at the same time, prove so great a source of pleasure? Upon what is this gratuitous supposition founded? And though it should be granted, would it not follow, that the same chord should successively and rapidly affect us with contrary sensations, since the vibrations are alternately coincident and discrepant? On the other hand, how should the ear be so sensible to the simplicity of relations, whilst for the most part these relations are entirely unknown to him whose organs are notwithstanding sensibly affected with the charms of agreeable music? We may conceive without difficulty how the eye judges of relations; but how does the ear form similar judgments? Besides, why should certain chords which are extremely pleasing in themselves, such as the fifth, lose almost nothing of the pleasure which they give us, when they are altered, and of consequence when the simplicity of their relations are destroyed; whilst other chords, which are likewise extremely agreeable, such as the third, become harsh almost by the smallest alteration; nay, whilst the most perfect and the most agreeable of all chords, the octave, cannot suffer the most inconsiderable change? Let us in sincerity confess our ignorance concerning the genuine causes of these effects (H). The metaphysical

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Metaphysical conclusions inadequate.

(H) We have as great an aversion as our author to the explication of musical phenomena from mechanical principles; yet we fear the following observations, deduced from irresistible and universal experience, evidently show that the latter necessarily depend on the former. It is, for instance, universally allowed, that dissonances grate, and concords please a musical ear: It is likewise no less unanimously agreed, that in proportion as a chord is perfect, the pleasure is increased; now the perfection of a chord consists in the regularity and frequency of coincident oscillations between two sonorous bodies impelled to vibrate: thus the third is a chord less perfect than the fifth, and the fifth than the octave. Of all these consonances, therefore, the octave is most pleasing to the ear; the fifth next, and the third last. In absolute discords, the vibrations are never coincident, and of consequence a perpetual pulsation or jarring is recognised between the protracted sounds, which exceedingly hurts the ear; but in proportion as the vibrations coincide, those pulsations are superseded, and a kindred formed betwixt the two continued sounds, which delights even the corporeal sense: that relation, therefore, without recognizing the aptitudes which produce it, must be the obvious cause of the pleasure which chords give to the ear. What we mean by coincident vibrations is, that while one sonorous body performs a given number of vibrations, another performs a different number in the same time: so that the vibrations of the quickest must sometimes be simultaneous with those of the slowest, as will plainly appear from the following

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physical conjectures concerning the acoustic organs are probably in the same predicament with those which are formed concerning the organs of vision, if one may speak so, in which philosophers have even till now made such inconsiderable progress, and in all likelihood will not be surpassed by their successors.

Since the theory of music, even to those who confine themselves within its limits, implies questions from which every wise musician will abstain; with much greater reason should they avoid idle excursions beyond the boundaries of that theory, and endeavours to investigate between music and the other sciences chimerical relations which have no foundation in nature. The singular opinions advanced upon this subject by some even of the most celebrated musicians, deserve not to be rescued from oblivion, nor refuted; and ought only to be regarded as a new proof how far men of genius may err, when they engage in subjects of which they are ignorant.

The rules which we have attempted to establish concerning the track to be followed in the theory of the musical art, may suffice to show our readers the end which we have proposed, and which we have endeavoured to attain in this Work. We have here (we repeat it), nothing to do with the mechanical principles of protracted and harmonic tones produced by sonorous bodies; principles which have hitherto been and perhaps may yet be long explored in vain: we have less to do with the metaphysical causes of the sensations impressed on the mind by harmony; causes which are still less discovered, and which, according to all appearances, will remain latent in perpetual obscurity. We are alone concerned to show how the principal laws of harmony may be deduced from one single experiment; for which, if we may speak so, preceding artists have been under the necessity of groping in the dark. Preliminary Discourse.

With an intention to render this work as generally useful as possible, we have endeavoured to adapt it to the capacity even of those who are absolutely uninstructed in music. To accomplish this design, it appeared necessary to pursue the following plan.

Plan of the treatise.

To begin with a short introduction, in which are defined the technical terms most frequently used in this art; such as *chord*, *harmony*, *key*, *third*, *fifth*, *octave*, &c.

Afterwards to enter into the theory of harmony, which is explained according to M. Rameau, with all possible perspicuity. This is the subject of the *First Part;* which, as well as the introduction, presupposes no other knowledge of music than that of the names of the notes, C, D, E, F, G, A, B, which all the world knows (1).

The theory of harmony requires some arithmetical calculations, necessary for comparing sounds one with another. These calculations are short, simple, and may be comprehended by every one; they demand no operation but what is explained, and which every school-boy may perform. Yet, that even the trouble of this may be spared to such as are not disposed to take it, these calculations are not inserted in the text, but in the notes, which the reader may omit, if he can take for granted the propositions contained in the text which will be found proved in the notes.

These calculations we have not endeavoured to multiply; we could even have wished to suppress them, if it had been possible: so much did it appear to us to be apprehended that our readers might be misled upon this subject, and might either believe, or suspect us of believing,

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following deduction: Between the extremes of a third, the vibrations of the highest are as 5 to 4 of the lowest; those of the fifth as 3 to 2; those of the octave as 2 to 1. Thus it is obvious, that in proportion to the frequent coincidence of periodical vibrations, the compound sensation is more agreeable to the ear. Now, to inquire why that organ should be rather pleased with these than with the pulsation and tremulous motion of encountering vibrations which can never coalesce, would be to ask why the touch is rather pleased with polished than rough surfaces; or why the eye is rather pleased with the waving line of Hogarth than with sharp angles and abrupt or irregular prominences? No alteration of which any chord is susceptible will hurt the ear unless it should violate or destroy the regular and periodical coincidence of vibrations. When alterations can be made without this disagreeable effect, they form a pleasing diversity; but still this fact corroborates our argument, that in proportion as any chord is perfect, it is impatient of the smallest alteration; for this reason, even in temperament, the octave endures no alteration at all, and the fifth as little as possible.

(1.) In our former editions, the French syllabic names of the notes *ut*, *re*, *mi*, *fa*, *sol*, *la*, *si*, were retained, as being thought to convey the idea of the relative sounds more distinctly than the seven letters used in Britain. It is no doubt true, that by constantly using the syllables, and considering each as representing one certain sound in the scale, a singer will in time associate the idea of each sound with its proper syllable, so that he will habitually give *ut* the sound of the first or fundamental note, *re* that of a second, *mi* of a third, &c. but this requires a long time, and much application: and is, besides, useless in *modulation* or changes of the key, and in all instrumental music. Teachers of *sol-fa'ing* as it is called, or singing by the syllables, in Britain, have long discarded, (if they ever used), the syllables *ut*, *re*, and *si*: and the prevalent, and we think, the sounder opinion is now, that a scholar will, by attending to the sounds themselves rather than to their names, soon learn their distinct characters and relations to the key, and to each other, and be able of course to assign to each its proper degree in the scale which he employs for the time, by whatever name the note representing that degree may be generally known. See *Holden's Essay towards a Rational System of Music*, Part I. chap. i. § 32, 33.

We have therefore, in our present edition, preferred to the French syllables the British nomenclature by the letters C, D, E, F, G, A, B, as being more simple, more familiar to British musicians, and equally applicable to instrumental as to vocal music.

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believing, all this arithmetic necessary to form an artist. Calculations may indeed facilitate the understanding of certain points in the theory, as of the relations between the different notes in the gammut and of the temperament; but the calculations necessary for treating of these points are so simple, and of so little importance, that nothing can require a less ostentatious display. Let us not imitate those musicians, who believing themselves geometers, or those geometers who, believing themselves musicians, fill their writings with figures upon figures; imagining, perhaps, that this apparatus is necessary to the art. The propensity of adorning their works with a false air of science, can only impose upon ignorance, and render their treatises more obscure and less instructive.

Mathematical conclusions not transferable to sensible objects without caution.

This abuse of geometry in music may be condemned with so much more reason, that in this subject the foundations of those calculations are in some manner hypothetical, and can never arise to a degree of certainty above hypothesis. The relation of the octave as 1 to 2, that of the fifth as 2 to 3, that of the third major as 4 to 5, &c. are not perhaps the genuine relations established in nature; but only relations which approach them, and such as experience can discover. For are the results of experience any thing more but mere approaches to truth?

But happily these approximated relations are sufficient, though they should not be exactly agreeable to truth, for giving a satisfactory account of those phenomena which depend on the relations of sound; as in the difference between the notes in the gammut, of the alterations necessary in the fifth and third, of the different manner in which instruments are tuned, and other facts of the same kind. If the relations of the octave, of the fifth and of the third, are not exactly such as we have supposed them, at least no experiments can prove that they are not so; and since these relations are signified by a simple expression, since they are besides sufficient for all the purposes of theory, it would be useless, and contrary to sound philosophy, to invent other relations in order to form the basis of any system of music less easy and simple than that which we have delineated in this treatise.

The *second part* contains the most essential rules of composition*, or in other words the practice of harmony. These rules are founded on the principles laid down in the *first part*; yet those who wish to understand no more than is necessary for practice, without exploring the reasons why such practical rules are necessary, may limit the objects of their study to the *introduction* and the *second part*. They who have read the *first part*, will find at every rule contained in the *second*, a reference to that passage in the *first* where the reasons for establishing that rule are given.

* See *Composition*.

That we may not present at once too great a number of objects and precepts, we have transferred to the notes in the second part several rules and observations which are less frequently put in practice, which perhaps it may be proper to omit till the treatise is read a second time, when the reader is well acquainted with the essential and fundamental rules explained in it.

Preliminary Discourse.

Some rules, on account of their intricacy, transferred to the notes.

This second part presupposes, no more than the first, any habit of singing, nor even any knowledge of music; it only requires that one should know, not even the intonation, but merely the position of the notes in the cleff F on the fourth line, and that of G upon the second: and even this knowledge may be acquired from the work itself; for in the beginning of the second part we explain the position of the cleffs and of the notes. Nothing is necessary but to render it a little familiar, and any difficulty in it will disappear.

All the rules of composition not to be expected in an elementary essay.

It would be wrong to expect here all the rules of composition, and especially those which direct the composition of music in several parts, and which, being less severe and indispensable, may be chiefly acquired by practice, by studying the most approved models, by the assistance of a proper master, but above all by the cultivation of the ear and of the taste. This treatise is properly nothing else, if the expression may be allowed, but the rudiments of music, intended for explaining to beginners the fundamental principles, not the practical detail of composition. Those who wish to enter more deeply into this detail, will either find it in M. Rameau's treatise of harmony, or in the code of music which he published more lately (K), or lastly in the explication of the theory and practice of music by M. Bethizi (L); this last book appears to us clear and methodical (M).

Nature the essential mistress of musical composition.

Is it necessary to add, that in order to compose music in a proper taste, it is by no means enough to have familiarized with much application the principles explained in this treatise? Here can only be learned the mechanism of the art; it is the province of nature alone to accomplish the rest. Without her assistance, it is no more possible to compose agreeable music by having read these elements, than to write verses in a proper manner with the Dictionary of Richelet. In one word, it is the elements of music alone, and not the principles of genius, that the reader may expect to find in this treatise.

DEFINITIONS.

I. *What is meant by Melody, by Chord, by Harmony, by Interval.*

Melody, what.

1. *Melody* is a series of sounds which succeed one to another in a manner agreeable to the ear.

Chord and harmony, what.

2. A *Chord* is a combination of several sounds heard together; and *Harmony* is properly a series of chords of which the succession pleases the ear. A single chord is

(K) From my general recommendation of this code, I except the reflections on the principle of sound which are at the end, and which I should not advise any one to read.

(L) Printed at Paris by Lambert in the year 1754.

(M) In addition to the works mentioned in the text, we recommend to our readers, Holden's Essay, Glasgow 1770, Edin. 1805; Kollmann's Essay on Musical Harmony, 1796; his Essay on Musical Composition, fol. 1799; Shield's Introduction, 1800; and Dr Callcott's Musical Grammar, 1806.

Definitions

is likewise sometimes called *harmony*, to signify the coalescence of the sounds which form the chord, and the sensation produced in the ear by that coalescence. We shall occasionally use the word *harmony* in this last sense, but in such a manner as never to leave our meaning ambiguous.

See *Interval.*

3. An *Interval*, in melody and harmony, is the distance, or difference in pitch, between one sound, and another higher or lower than it.

4. That we may learn to distinguish the intervals, and the manner of perceiving them, let us take the ordinary scale C, D, E, F, G, A, B, c, which every person whose ear or voice is not extremely false naturally modulates. The following observations will occur to us in singing this scale.

Account of the simple intervals.

The sound D is higher or sharper than the sound C, the sound E higher than the sound D, the sound F higher than the sound E, &c. and so through the whole octave; so that the interval, or the distance from the sound C to the sound D, is less than the interval or distance between the sound C and the sound E, the interval from C to F is less than that between C and F, &c. and in short that the interval from the first to the second C is the greatest of all.—To distinguish the first from the second C, we have marked the last with a small letter (N).

Definitions

5. In general, the interval between two sounds is proportionably greater, as one of these sounds is higher or lower with relation to the other: but it is necessary to observe, that two sounds may be equally high or low, though unequal in their force. The string of a violin touched with a bow produces always a sound equally high, whether strongly or faintly struck; the sound will only have a greater or lesser degree of strength. It is the same with vocal modulation; let any one form a sound by gradually swelling the voice, the sound may be perceived to increase in force, whilst it continues always equally low or equally high.

The distinction between strong and faint, or acute and grave.

6. We must likewise observe concerning the scale, that the intervals between C and D, between D and E, between F and G, between G and A, between A and B, are equal, or at least nearly equal; and that the intervals between E and F, and between B and C, are likewise equal among themselves, but consist almost only of half the former. This fact is known and recognised by every one: the reason for it shall be given in the sequel; in the mean time every one may ascertain its reality by the assistance of an experiment (O.)

Between tonic and semitonic intervals.

7. It

(N) We shall afterwards find that three different series of the seven letters are used, which we have distinguished by capitals, small Roman, and Italic characters. When the notes represented by small Roman characters occur in this treatise we shall, merely to distinguish them from the typography of the text, place them in inverted commas, thus 'c', 'd', &c.

(O) This experiment may be easily tried. Let any one sing the scale C, D, E, F, G, A, B 'c', it will be immediately observed without difficulty, that the last four notes of the octave G, A, B, 'c', are quite similar to the first C, D, E, F; insomuch, that if, after having sung this scale, one would choose to repeat it, beginning with C in the same tone which was occupied by G in the former scale, the note D of the last scale would have the same sound with the note A in the first, the E with the B, and the F with the 'c'.

Whence it follows, that the interval between C and D, is the same as between G and A; between D and F, as between A and B, and E and F, as between B and 'c'.

From D to E, from F to G, there is the same interval as from C to D. To be convinced of this, we need only sing the scale once more; then sing it again, beginning with C, in this last scale, in the same tone which was given to D in the first; and it will be perceived, that the D in the second scale will have the same sound, at least as far as the ear can discover, with the E in the former scale; whence it follows, that the difference between D and E is, at least as far as the ear can perceive, equal to that between C and D. It will also be found, that the interval between F and G is, so far as our sense can determine, the same with that between C and D.

This experiment may perhaps be tried with some difficulty by those who are not inured to form the notes and change the key; but such may very easily perform it by the assistance of a harpsichord, by means of which the performer will be saved the trouble of retaining the sounds in one intonation whilst he performs another. In touching upon this harpsichord the keys G, A, B, 'f', and in performing with the voice at the same time C, D, E, F, in such a manner that the same sound may be given to C in the voice with that of the key G in the harpsichord, it will be found that D in the vocal intonation shall be the same with A upon the harpsichord, &c.

It will be found likewise by the same harpsichord, that if one should sing the scale beginning with C in the same tone with E on the instrument, the D, which ought to have followed C, will be higher by an extremely perceptible degree than the F which follows E: thus it may be concluded, that the interval between E and F is less than between C and D; and if one would rise from F to another sound which is at the same distance from F, as F from E, he would find, in the same manner, that the interval from E to this new sound is almost the same as that between C and D. The interval then from E to F is nearly half of that between C and D.

Since then, in the scale thus divided, C, D, E, F, / G, A B, 'c',

the first division is perfectly like the last; and since the intervals between C and D, between D and E, and between F and G, are equal; it follows, that the intervals between G and A, and between A and B, are likewise equal to every one of the three intervals between C and D, between D and E, and between F and G; and that the intervals between E and F and between B and 'c' are also equal, but that they only constitute one half of the others.

Definitions. 7. It is for this reason that they have called the interval from E to F, and from B to C, a semitone; whereas those between C and D, D and E, F and G, G and A, and A and B, are tones.

* Plate CCCLIV. fig. 1. † See *Interval*.

The *tone* is likewise called a *second major* *, and the *semitone* a *second minor* †.

8. To descend or rise diatonically, is to descend or rise from one sound to another by the interval of a tone or of a semitone, or in general by seconds, whether major or minor; as from D to C, or from C to D, from F to E, or from E to F.

II. *The terms by which the different Intervals of the Scale are denominated.*

Third minor, what. 9. An interval composed of a tone and a semitone, as from E to G, from A to C, or from D to F, is called a *third minor*.

Third major, what. An interval composed of two full tones, as from C to E, and from F to A, or from G to B, is called a *third major*.

Fourth, what. An interval composed of two tones and a semitone, as from C to F, or from G to C, is called a *fourth*.

Tritone, what. An interval consisting of three full tones, as from F to B, is called a *tritone* or *fourth redundant*.

Fifth, what. An interval consisting of three tones and a semitone, as from C to G, from F to C, from D to A, or from E to B, &c. is called a *fifth*.

Sixth minor, what. An interval composed of three tones and two semitones, as from E to C, is called a *sixth minor*.

Sixth major, what. An interval composed of four tones and a semitone, as from C to A, is called a *sixth major*.

Seventh minor, what. An interval consisting of four tones and two semitones, as from D to C, is called a *seventh minor*

Seventh major, what. An interval composed of five tones and a semitone, as from C to B, is called a *seventh major*.

Octave, what. And in short, an interval consisting of five tones and two semitones, as from C to 'c' is called an *octave*.

Several of the intervals now mentioned, are distinguished by other names, as may be seen in the beginning of the second part; but those now given are the most common, and the only terms which our present purpose demands.

Unison, what. 10. Two sounds equally high, or equally low, however unequal in their force, are said to be in *unison* one with the other. Definitions.

11. If two sounds form between them any interval, whatever it be, we say, that the highest when ascending is in that interval with relation to the lowest; and when descending, we pronounce the lowest in the same interval with relation to the highest. Thus in the third minor, E, G, where E is the lowest and G the highest sound, G is a third minor from E *ascending*, and E is a third minor from G in *descending*.

12. In the same manner, if, speaking of two sonorous bodies, we should say, that the one is a fifth above the other *in ascending*; this infers that the sound given by the one is at the distance of a fifth *ascending* from the sound given by the other.

III. *Of Intervals greater than the Octave.*

13. If, after having sung the scale C, D, E, F, G, A, B, c, one would carry this scale still farther in ascent, it would be discovered without difficulty that a new scale would be formed, 'c, d, e, f', &c. entirely similar to the former, and of which the sounds will be an octave ascending, each to its correspondent note in the former scale; thus 'd', the second note of the second scale, will be an octave in ascent to the D of the first scale; in the same manner 'e' shall be the octave to E, &c. and so of the rest. Fig. 2.

14. As there are nine notes from the first C to the second 'd', the interval between these two sounds is called a *ninth*, and this ninth is composed of six full tones and two semitones. For the same reason, the interval from C to 'f' is called an *eleventh*, and the interval between C and 'g' a *twelfth*, &c. Ninth, what.

It is plain that the *ninth* is the octave of the *second*, the *eleventh* of the *fourth*, and the *twelfth* of the *fifth*, &c. Eleventh and twelfth, what.

The octave above the octave of any sound is called a *double octave* *; the octave of the double octave is called a *triple octave*, and so of the rest. * See *Interval* and *Double Octave*.

The double octave is likewise called a *fifteenth*: and for the same reason the double octave of the third is called a *seventeenth*, the double octave of the fifth a *nineteenth*, &c. (P).

IV.

(P) Let us suppose two vocal strings formed of the same matter, of the same thickness, and equal in their tension, but unequal in their length; it will be found by experience,

1*st*, That if the shortest is equal to half the longest, the sound which it will produce must be an octave above the sound produced by the longest.

2*dly*, That if the shortest constitutes a third part of the longest, the sound which it produces must be a twelfth above the sound produced by the longest.

3*dly*, That if it constitutes the fifth part, its sound will be a seventeenth above.

Besides, it is a truth demonstrated and generally admitted, that in proportion as one musical string is less than another, the vibrations of the least will be more frequent (that is to say, its departures and returns through the same space) in the same time; for instance, in an hour, a minute, a second, &c. in such a manner that one string which constitutes a third part of another, forms three vibrations, whilst the largest has only accomplished one. In the same manner, a string which is one half less than another, performs two vibrations, while the other only completes one; and a string which is only the fifth part of another, will perform five vibrations in the same time which is occupied by the other in one.

From thence it follows, that the sound of a string is proportionally higher or lower, as the number of its vibrations is greater or smaller in a given time; for instance, in a second.

It is for that reason, that if we represent any sound whatever by 1, one may represent the octave above by 2, that is to say, by the number of vibrations formed by the string which produces the octave, whilst the longest string only vibrates once; in the same manner we may represent the twelfth above the sound 1 by 3, the seventeenth

Definitions.

IV. *What is meant by Sharps and Flats.*

Sharps and flats, what. See *Interval.*

15. It is plain that one may imagine the five tones which enter into the scale, as divided each into two semitones; thus one may advance from C to D, forming in his progress an intermediate sound, which shall be higher by a semitone than C, and lower in the same degree than D. A sound in the scale is called *sharp*, when it is raised by a semitone; and it is marked with this character ♯: thus C ♯ signifies C *sharp*, that is to say, C raised by a semitone above its pitch in the natural scale. A sound in the scale depressed by a semitone is called *flat*, and is marked thus, ♭: thus A ♭ signifies A *flat*, or A depressed by a semitone.

V. *What is meant by Consonances and Dissonances.*

Consonance, what. See *Chord.*

16. A chord composed of sounds whose union or coalescence pleases the ear is called *consonance;* and the sounds which form this chord are said to be consonant one with relation to the other. The reason of this denomination is that a chord is found more perfect, as the sounds which form it coalesce more closely among themselves. Definition

17. The octave of a sound is the most perfect of consonances of which that sound is susceptible; then the fifth, afterwards the third, &c. This is a fact founded on experiment.

Dissonance, what.

18. A number of sounds simultaneously produced whose union is displeasing to the ear is called a *dissonance*, and the sounds which form it are said to be dissonant one with relation to the other. The second, the tritone, and the seventh of a sound, are dissonants with relation to it. Thus the sounds C D, C B, or F B, &c. simultaneously heard, form a dissonance. The reason which renders dissonance disagreeable, is, that the sounds which compose it, seem by no means coalescent to the ear, and are heard each of them by itself as distinct sounds, though produced at the same time. See *Discord.*

PART I. THEORY OF HARMONY.

CHAP. I. *Preliminary and Fundamental Experiments.*

EXPERIMENT I.

19. WHEN a sonorous body is struck till it gives a sound, the ear, besides the principal sound and its octave, perceives two other sounds very high, of which one is the twelfth above the principal sound, that is to say, the octave to the fifth of that sound; and the other is the seventeenth major above the same sound, that is to say, the double octave of its third major.

20. This experiment is peculiarly sensible upon the thick strings of the violoncello, of which the sound being extremely low, gives to an ear, though not very much practised, an opportunity of distinguishing with sufficient ease and clearness the twelfth and seventeenth now in question (q).

21.

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tenth major above 5, &c. But it is very necessary to remark, that by these numerical expressions we do not pretend to compare sounds as such; for sounds in themselves are nothing but mere sensations, and it cannot be said of any sensation that it is double or triple to another: thus the expressions 1, 2, 3, &c. employed to denominate a sound, its octave above, its twelfth above, &c. signify only, that if a string performs a certain number of vibrations, for instance, in a second, the string which is in the octave above shall double the number in the same time, the string which is in the twelfth above shall triple it, &c.

Thus to compare sounds among themselves is nothing else to than compare among themselves the number of vibrations which are formed in a given time by the strings that produce these sounds.

(q) Since the octave above the sound 1 is 2, the octave below the same sound shall be $\frac{1}{2}$; that is to say, that the string which produces this octave shall have performed half its vibration, whilst the string which produces the sound 1 shall have completed one. To obtain therefore the octave above any sound, the operator must multiply the quantity which expresses the sound by 2; and to obtain the octave below, he must on the contrary divide the same quantity by 2.

It is for that reason that if any sound whatever, for instance C, is denominated	1
Its octave above will be	2
Its double octave above	4
Its triple octave above	8
In the same manner its octave below will be	$\frac{1}{2}$
Its double octave below	$\frac{1}{4}$
Its triple octave below	$\frac{1}{8}$
And so of the rest.	
Its twelfth above	3
Its twelfth below	$\frac{1}{3}$
Its 17th major above	5
Its 17th major below	$\frac{1}{5}$

The fifth then above the sound 1 being the octave beneath the twelfth, shall be, as we have immediately observed,

Theory of Harmony.

21. The principal sound is called the *generator* *; and the two other sounds which it produces, and with which it is accompanied, are, inclusive of its octave, called its *harmonics* †.

* See *Generator*.
Generator, what.
† See *Harmonic*.

Theory of Harmony.

Experiment II.

22. There is no person insensible of the resemblance which subsists between any sound and its octave, whether above or below. These two sounds, when heard together, almost entirely coalesce in the organ of sensation. We may besides be convinced (by two facts which are extremely simple) of the facility with which one of these sounds may be taken for the other.

Let it be supposed that any person has an inclination to sing a tune, and having at first begun this air upon a pitch too high or too low for his voice, so that he is obliged, lest he should strain himself too much, to sing the tune in question on a key higher or lower than the first; he will naturally, without being initiated in the art of music, take his new key in the octave below or the octave above the first; and in order to take this key in any other interval except the octave, he will find it necessary to exert a sensible degree of attention. This is a fact of which we may easily be persuaded by experience.

Another fact. Let any person sing a tune in our presence, and let it be sung in a tone too high or too low for our voice; if we wish to join in singing this air, we naturally take the octave below or above, and frequently, in taking this octave, we imagine it to be the unison (Q*).

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served, $\frac{3}{2}$; which signifies that this string performs $\frac{3}{2}$ vibrations; that is to say, one vibration and a half during a single vibration of the string which gives the sound 1.

To obtain the fourth above the sound 1, we must take the twelfth below that sound, and the double octave above that twelfth. In effect, the twelfth below C, for instance, is F, of which the double octave *f* is the fourth above *c*. Since then the twelfth below 1 is $\frac{1}{3}$, it follows that the double octave above this twelfth, that is to say, the fourth from the sound 1 in ascending, will be $\frac{1}{3}$ multiplied by 4, or $\frac{4}{3}$.

In short, the third major being nothing else but the double octave beneath the seventeenth, it follows, that the third major above the sound 1 will be 5 divided by 4, or in other words $\frac{5}{4}$.

The third major of a sound, for instance the third major E, from the sound C, and its fifth G, form between them a third minor E, G; now E is $\frac{5}{4}$, and G $\frac{3}{2}$, by what has been immediately demonstrated: from whence it follows, that the third minor, or the interval between E and G, shall be expressed by the relation of the fraction $\frac{5}{4}$ to the fraction $\frac{3}{2}$.

To determine this relation, it is necessary to remark, that $\frac{5}{4}$ are the same thing with $\frac{10}{8}$, and that $\frac{3}{2}$ are the same thing with $\frac{12}{8}$: so that $\frac{5}{4}$ shall be to $\frac{3}{2}$ in the same relation as $\frac{10}{8}$ to $\frac{12}{8}$; that is to say, in the same relation as 10 to 12, or as 5 to 6. If, then, two sounds form between themselves a third minor, and that the first is represented by 5, the second shall be expressed by 6; or, what is the same thing, if the first is represented by 1, the second shall be expressed by $\frac{6}{5}$.

Thus the third minor, an harmonic sound which is even found in the protracted and coalescent tones of a sonorous body between the sound E and G, an harmonic of the principal sound, may be expressed by the fraction $\frac{6}{5}$.

N. B. One may see by this example, that in order to compare two sounds one with another which are expressed by fractions, it is necessary first to multiply the numerator of the fraction which expresses the first by the denominator of the fraction which expresses the second, which will give a primary number; as here the numerator 5 of the fraction $\frac{5}{4}$, multiplied by 2 of the fraction $\frac{2}{1}$, has given 10. Afterwards may be multiplied the numerator of the second fraction by the denominator of the first, which will give a secondary number, as here 12 is the product of 4 multiplied by 3; and the relation between these two numbers (which in the preceding example are 10 and 12), will express the relation between these sounds, or, what is the same thing, the interval which there is between the one and the other; in such a manner, that the farther the relation between these sounds departs from unity, the greater the interval will be.

Such is the manner in which we may compare two sounds one with another whose numerical value is known. We shall now show the manner how the numerical expression of a sound may be obtained, when the relation which it ought to have with another sound is known whose numerical expression is given.

Let us suppose, for example, that the third major of the fifth $\frac{3}{2}$ is sought. That third major ought to be, by what has been shown above, the $\frac{5}{4}$ of the fifth; for the third major of any sound whatever is the $\frac{5}{4}$ of that sound. We must then look for a fraction which expresses the $\frac{5}{4}$ of $\frac{3}{2}$; which is done by multiplying the numerators and denominators of both fractions one by the other, from whence results the new fraction $\frac{15}{8}$. It will likewise be found that the fifth of the fifth is $\frac{9}{4}$, because the fifth of the fifth is the $\frac{3}{2}$ of $\frac{3}{2}$.

Thus far we have only treated of fifths, fourths, thirds major and minor, in ascending; now it is extremely easy to find by the same rules the fifths, fourths, thirds major and minor in descending. For suppose C equal to 1, we have seen that its fifth, its fourth, its third, its major and minor in ascending, are $\frac{3}{2}$, $\frac{4}{3}$, $\frac{5}{4}$, $\frac{6}{5}$. To find its fifth, its fourth, its third, its major and minor in descending, nothing more is necessary than to reverse these fractions, which will give $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{6}$.

(Q*) It is not then imagined that we change the value of a sound in multiplying or dividing it by 2, by 4, or by 8, &c. the number which expresses these sounds, since by these operations we do nothing but take the simple double, or triple octave, &c. of the sound in question, and that a sound coalesces with its octave.

Theory of Harmony.

CHAP. II. *The Origin of the Modes Major and Minor; of the most natural Modulation, and the most perfect Harmony.*

Fundamental and harmonics, what.

23. To render our ideas still more precise and permanent, we shall call the tone produced by the sonorous body C: it is evident, by the first experiment, that this sound is always attended by its 12th and 17th major; that is so say, with the octave of G, and the double octave of E.

24. This octave of G then, and this double octave of E, produce the most perfect chord which can be joined with C, since that chord is the work and choice of nature (R).

Harmony reduced to chords, fifths, and octaves.

25. For the same reason, the modulation formed by C with the octave of G, and the double octave of E, sung one after the other, would likewise be the most simple and natural of all modulations which do not descend or ascend directly in the diatonic order, if our voices had sufficient compass to form intervals so great without difficulty: but the ease and freedom with which we can substitute its octave to any sound, when it is more convenient for the voice, afford us the means of representing this modulation.

Mode major, what.

26. It is on this account that, after having sung the tone C, we naturally modulate the third E, and the fifth G, instead of the double octave of E, and the octave of G; from whence we form, by joining the octave of the sound G, this modulation, C, E, G, 'c', which in effect is the simplest and easiest of them all; and which likewise has its origin even in the protracted and compounded tones produced by a sonorous body.

See *Mode*. See likewise *Interval*.

27. The modulation C, E, G, 'c', in which the chord C, E, is a third major, constitutes that kind of harmony or melody which we call the *mode major;* from whence it follows, that this mode results from the immediate operation of nature.

Mode minor, what.

28. In the modulation C, E, G, of which we have now been treating, the sounds E and G are so proportioned one to the other, that the principal sound C (art. 19.) causes both of them to resound; but the second tone E does not cause G to resound, which only forms the interval of a third minor.

Theory of Harmony.

29. Let us then imagine, that, instead of this sound E, one should substitute between the sounds C and G, another note which (as well as the sound C) has the power of causing G to resound, and which is, however, different from the sound C; the sound which we explore ought to be such, by art. 19. that it may have for its 17th major G, or one of the octaves of G; of consequence the sound which we seek ought to be a 17th major below G, or, what is the same thing, a third major below the same G. Now the sound E being a third minor beneath G, and the third major being (art. 9.) greater by a semitone than the third minor, it follows, that the sound of which we are in search shall be a semitone beneath the natural E, and of consequence E ♭.

30. This new arrangement, C, E ♭, G, in which the sounds C and E ♭ have both the power of causing G to resound, though C does not cause E ♭ to resound, is not indeed equally perfect with the first arrangement C, E, G; because in this the two sounds E and G are both the one and the other generated by the principal sound C; whereas, in the other, the sound E ♭, is not generated by the sound C; but this arrangement C, E ♭, G, is likewise dictated by nature (art. 19.), though less immediately than the former; and accordingly experience evinces that the ear accommodates itself almost as well to the latter as to the former.

Origin of mode minor. See *Mode*. See also *Interval*.

31. In this modulation or chord C, E ♭, G, C, it is evident that the third from C to E ♭ is minor; and such is the origin of that mode which we call *minor* (S).

Perfect chords, what.

32. The most perfect chords then are, 1. All chords related one to another, as C, E, G, 'c', consisting of any sound, of its third major, of its fifth, and of its octave. 2. All chords related one to another, as C, E ♭, G, 'c', consisting of any sound, of its third minor,

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(R) The chord formed with the twelfth and seventeenth major united with the principal sound, being exactly conformed to that which is produced by nature, is likewise for that reason the most agreeable of all; especially when the composer can proportion the voices and instruments together in a proper manner to give this chord its full effect. M. Rameau has executed this with the greatest success in the opera of *Pygmalion*, page 34. where Pygmalion sings with the chorus *L'amour triomphe*, &c.: in this passage of the chorus, the two parts of the vocal and instrumental basses give the principal sound and its octave; the first part above, or treble, and that of the counter-tenor, produce the seventeenth major, and its octave, in descending; and the second part, or tenor above, gives the twelfth.

See fig. 3.

(S) The origin which we have here given of the mode minor, is the most simple and natural that can possibly be given. M. Rameau deduces it, more artificially, from the following experiment:—If you put in vibration a musical string HI, and if there are at the same time contiguous to this two other strings KN, RW, of which the first shall be a twelfth, and the second a seventeenth major below the string HI, the strings KN, RW will vibrate without being struck as soon as the string HI shall give a sound, and divide themselves by a kind of undulation, the first into three, the last into five equal parts; in such a manner, that, in the vibration of the string KN, you may easily distinguish two points at rest LM, and in the tremulous motion of the string RW, four quiescent points S, T, U, V, all placed at equal distances from each other, and dividing the strings into three or five equal parts. In this experiment, says M. Rameau, if we represent by the note C the tone of the string HI, the two other strings will represent the sounds F and A ♭; and from thence M. Rameau deduces the modulation F, A ♭, C, and of consequence the mode minor. The origin which we have assigned to the minor mode, appears more direct and more simple, because it presupposes no other experiment than that of art. 19. and because also the fundamental sound C is still retained in both the modes, without being obliged, as M. Rameau found himself, to change it into F.

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minor, of its fifth, and of its octave. In effect, these two kinds of chords are exhibited by nature; but the first more immediately than the second. The first are called *perfect chords major*, the second *perfect chords minor*.

Chap. III. *Of the Succession by Fifths, and of the Laws which it observes.*

Fundamental bass, what.

33. Since the sound C causes the sound G to be heard, and is itself heard in the sound F, which sounds G and F are its two twelfths, we may imagine a modulation composed of that sound C and its two twelfths, or, which is the same thing (art. 22.) of its two fifths, F and G, the one below, the other above; which gives the modulation or series of fifths F, C, G, which we call the *fundamental bass* of C by fifths.

We shall find in the sequel (Chap. XVIII.), that there may be some fundamental bass by thirds, deduced from the two seventeenths, of which the one is an attendant of the principal sound, and of which the other includes that sound. But we must advance step by step, and satisfy ourselves at present to consider immediately the fundamental bases by fifths.

34. Thus, from the sound C, one may make a transition indifferently to the sound G, or to the sound F.

35. One may, for the same reason, continue this kind of fifths in ascending, and in descending, from C, in this manner:

E♭, B♭, F, C, G, D, A, &c.

And from this series of fifths one may pass to any sound which immediately precedes or follows it.

Exception to the rule.

36. But it is not allowed in the same manner to pass from one sound to another which is not immediately contiguous to it; for instance, from C to D, or from D to C: for this very simple reason, that the sound D is not contained in the sound C, nor the sound C in that of D; and thus these sounds have not any allianee the one with the other, which may authorise the transition from one to the other.

Two perfect chords in succession proscribed.

37. And as these sounds C and D, by the first experiment, naturally bring along with them the perfect chords consisting of greater intervals C, E, G, 'c', and D, F♯, A, 'd'; hence may be deduced this rule, That two perfect chords, especially if they are major (T), cannot succeed one another diatonically in a fundamental bass; we mean, that in a fundamental bass two sounds cannot be diatonically placed in succession, each of which, with its harmonics, forms a perfect chord, especially if this perfect chord be major in both.

Chap. IV. *Of Modes in General.*

Mode in general, what.

38. A *mode*, in music, is, the order of sounds prescribed, as well in harmony as melody, by the series of fifths. Thus the three sounds, F, C, G, and the harmonics of each of these three sounds, that is to say, their thirds major and their fifths, compose all the major modes which are proper to C. Theory of Harmony.

Modes, how represented by the series of fifths.

39. The series of fifths then, or the fundamental bass F, C, G, of which C holds the middle space, may be regarded as representing the mode of C. One may likewise take the series of fifths, or fundamental bass, C, G, D, as representing the mode of G; in the same manner B♭, F, C, will represent the mode of F.

Thus the mode of G, or rather the fundamental bass of that mode, has two sounds in common with the fundamental bass of the mode of C. It is the same with the fundamental bass of the mode F.

Principal mode, and adjuncts, what. See *Adjunct.*

40. The mode of C (F, C, G) is called the *principal mode* with respect to the modes of these two fifths, which are called its two *adjuncts*.

Modes relished in proportion as their sounds are common.

41. It is then, in some measure, indifferent to the ear whether a transition be made to the one or to the other of these adjuncts, since each of them has equally two sounds in common with the principal mode. Yet the mode of G seems a little more eligible: for G is heard amongst the harmonics of C, and of consequence is implied and signified by C; whereas C does not cause F to be heard, though C is included in the same sound F. It is hence that the ear, affected by the mode of C, is a little more prepossessed for the mode of G than for that of F. Nothing likewise is more frequent, nor more natural, than to pass from the mode of C to that of G.

Dominant and sub-dominant, what. See *Dominant.*

42. It is for this reason, as well as to distinguish the two fifths one from the other, that we call G the fifth above the generator the *dominant* sound, and the fifth F, below the generator, the *subdominant*.

Transition to contiguous sounds, how to be managed.

43. As in the series of fifths, we may indifferently pass from one sound to that which is contiguous: so having passed from the mode of C to that of G, one may from thence proceed to the mode of D. And on the other hand, having passed from the mode of C to that of F we may then pass to the mode of B♭. But it is necessary, however, to observe, that the ear, which has been immediately affected with the principal mode, feels always a strong propensity to return to it. Thus the further the mode to which we make a transition is removed from the principal mode, the less time we ought to dwell upon it; or rather, to speak in the terms of the art, the less ought the phrase (U) of that mode to be protracted.

Chap. V. *Of the Formation of the Diatonic Scale as used by the Greeks.*

44. From this rule, that two sounds which are contiguous may be placed in immediate succession in the series of fifths, F, C, G, it follows, that one may

(T) We say *especially if they are major;* for in the major chord D, F♯, A, 'd', besides that the sounds C and D have no common harmonical relation, and are even dissonant between themselves (art 13.) it will likewise be found, that F♯ forms a dissonance with C. The minor chord D, F, A, 'd', would be more tolerable, because the natural F, which occurs in this chord carries along with it its fifth C, or rather the octave of that fifth: It has likewise been sometimes the practice of composers, though rather by a licence indulged them than strictly agreeable to their art, to place a minor in diatonic succession to a major chord.

(U) As the mere English reader, unacquainted with the technical phraseology of music, may be surprised at the

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form this modulation, or this fundamental bass, by fifths, G, C, G, C, F, C, F.

45. Each of the sounds which forms this modulation brings necessarily along with itself its third major, its fifth, and its octave; insomuch that he who, for instance, sings the note G, may be reckoned to sing at the same time the notes G, B, 'd, g': in the same manner the sound C in the fundamental bass brings along with it this modulation, C, E, G, C: and, in short, the sound F brings along with it F, A, C, 'f'. This modulation then, or this fundamental bass,

G, C, G, C, F, C, F,

gives the following diatonic series,

B, 'c, d, e, f, g, a';

which is precisely the diatonic scale of the Greeks. We are ignorant upon what principles they had formed this scale; but it may be sensibly perceived, that that series arises from the bass G, C, G, C, F, C, F; and that of consequence this bass is justly called *fundamental, as* being the real primitive modulation, that which conducts the ear, and which it feels to be implied in the diatonic modulation, B, 'c, d, e, f, g, a' (x).

See fig. 4. Formation of the Greek diatonic scale by the fundamental bass.

See fig. 4.

46. We shall be still more convinced of this truth by the following remarks.

In the modulation B, 'c, d, e, f, g, a', the sounds 'd' and 'f' form between themselves a third minor, which is not so perfectly true as that between 'e' and 'g' (y). Nevertheless, this alteration in the third minor between 'd' and 'f' gives the ear no pain, because that 'd' and that 'f' which do not form between themselves a true third minor, form, each in particular, consonances perfectly just with the sounds in the fundamental bass which correspond with them: for 'd' in the scale is the true fifth of G, which answers to it in the fundamental bass; and 'f' in the scale is the true octave of F, which answers to it in the same bass.

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47. If, therefore, these sounds in the scale form consonances perfectly true with the notes which correspond to them in the fundamental bass, the ear gives itself little trouble to investigate the alterations which there may be in the intervals which these sounds in the scale form between themselves. This is a new proof that the fundamental bass is the genuine guide of the ear, and the true origin of the diatonic scale.

Altered intervals, no objection.

48. Moreover, this diatonic scale includes only seven sounds, and goes no higher than 'b', which would be the octave of the first: a new singularity, for which a reason may be given by the principles above established.

Reasons why this scale includes only seven sounds.

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the use of the word *phrase* when transferred from language to that art, we have thought proper to insert the definition of Rousseau.

A *phrase*, according to him, is in melody a series of modulations, or in harmony a succession of chords, which form without interruption a sense more or less complete, and which terminates in a repose by a cadence more or less perfect.

(x) Nothing is easier than to find in this scale the value or proportions of each sound with relation to the sound C, which we call 1; for the two sounds G and F in the bass are $\frac{3}{2}$ and $\frac{2}{3}$; from whence it follows,

1. That 'c' in the scale is the octave of C in the bass; that is to say, 2.
2. That 'b' is the third major of G; that is to say $\frac{5}{4}$ of $\frac{3}{2}$ (note Q), and of consequence $\frac{15}{8}$.
3. That 'd' is the fifth of G; that is to say $\frac{3}{2}$ of $\frac{3}{2}$, and of consequence $\frac{9}{4}$.
4. That 'e' is the third major of the octave of C, and of consequence the double of $\frac{5}{4}$; that is to say, $\frac{5}{2}$.
5. That 'f' is the double octave of F of the bass, and consequently $\frac{8}{3}$.
6. That 'g' of the scale is the octave of G of the bass, and consequently 3.
7. That 'a' in the scale is the third major of 'f' of the scale; that is to say, $\frac{5}{4}$ of $\frac{8}{3}$, or $\frac{10}{3}$.

Hence then will result the following table, in which each sound has its numerical value above or below it.

Diatonic Scale.	$\frac{15}{8}$	2	$\frac{9}{4}$	$\frac{5}{2}$	$\frac{8}{3}$	3	$\frac{10}{3}$
	B,	c,	d,	e,	f,	g,	a.
Fundamental Bass.	G,	C,	G,	C,	F,	C,	F.
	$\frac{3}{2}$	1,	$\frac{3}{2}$	1	$\frac{2}{3}$	1	$\frac{2}{3}$

And if, for the conveniency of calculation, we choose to call the sound C of the scale 1; in this case we have only to divide each of the numbers by 2, which represent the diatonic scale, and we shall have

$\frac{15}{16}$	1	$\frac{9}{8}$	$\frac{5}{4}$	$\frac{4}{3}$	$\frac{3}{2}$	$\frac{5}{3}$
B,	c,	d,	e,	f,	g,	a.

(y) In order to compare 'd' with 'f', we need only compare $\frac{9}{8}$ with $\frac{4}{3}$; the relation between these fractions will be, (note c) that of 9 times 3 to 8 times 4; that is to say, of 27 to 32: the third minor, then, from 'd' to 'f', is not true; because the proportion of 27 to 32 is not the same with that of 5 to 6, these two proportions being between themselves as 27 times 6 is to 32 times 5, that is to say, as 162 to 160, or as the halves of these two numbers, that is to say, as 81 to 80.

M. Rameau, when he published, in 1726, his *New theoretical and practical System of Music*, had not as yet found the true reason of the alteration in the consonance which is between 'd' and 'f', and of the little attention which the ear pays to it. For he pretends, in the work now quoted, that there are two thirds minor, one in the proportion of 5 to 6, the other in the proportion of 27 to 32. But the opinion which he has afterwards adopted, seems much preferable. In reality, the genuine third minor, is that which is produced by nature between 'e' and 'g', in the continued tone of those sonorous bodies of which 'e' and 'g' are the two harmonics: and that third minor, which is in the proportion of 5 to 6, is likewise that which takes place in the minor mode, and not that third minor which is false and different, being in the proportion of 27 to 32.

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ed. In reality, in order that the sound 'b' may succeed immediately in the scale to the sound 'a', it is necessary that the note 'g', which is the only one from whence 'b' as a harmonic may be deduced, should immediately succeed to the sound 'f', in the fundamental bass, which is the only one from whence 'a' can be harmonically deduced. Now, the diatonic succession from F to G cannot be admitted in the fundamental bass, according to what we have remarked (art. 36.). The sounds 'a' and 'b', then, cannot immediately succeed one another in the scale: we shall see in the sequel why this is not the case in the series 'c, d, e, f, g, a, b', c, which begins upon C; whereas the scale in question here begins upon B.

Completion of the Greek octave. See *Prostambanomene.*

49. The Greeks likewise, to form an entire octave, added below the first B the note A, which they distinguished and separated from the rest of the scale, which for that reason they called *prostambanomene*, that is to say, a string or note subadded to the scale, and put before B to form the entire octave.

The scale composed of two similar conjunctive tetrachords.

50. The diatonic scale B, 'c, d, e, f, g, a', is composed of two tetrachords, that is to say, of two diatonic scales, each consisting of four sounds, B, 'c, d, e', and 'e, f, g, a'. These two tetrachords are exactly similar; for from 'e' to 'f' there is the same interval as from B to 'c', from 'f' to 'g' the same as from 'c' to 'd', from 'g' to 'a' the same as from 'd' to 'e' (z): this is the reason why the Greeks distinguished these two tetrachords; yet they joined them by the note 'a' which is common to both, and which gave them the name of *conjunctive tetrachords*.

Intervals in both tetrachords equal.

51. Moreover, the intervals between any two sounds, taken in each tetrachord in particular, are precisely true: thus, in the first tetrachord, the intervals of C 'e', and B 'd', are thirds, the one major and the other minor, exactly true, as well as the fourth B 'e' (AA); it is the same thing with the tetrachord 'e, f, g, a', since this tetrachord is exactly like the former.

Intervals between the notes of different tetrachords dissimilar.

52. But the case is not the same when we compare two sounds taken each from a different tetrachord; for we have already seen, that the note 'd' in the first tetrachord forms with the note 'f' in the second a third minor, which is not true. In like manner it will be found, that the fifth from 'd' to 'a' is not exactly true, which is evident; for the third major from 'f' to 'a' is true, and the third minor from 'd' to 'f' is not so: now, in order to form a true fifth, a third major and a third minor, which are both exactly true, are necessary. Theory of Harmony.

Another reason for distinguishing the scale into two tetrachords.

53. From thence it follows, that every consonance is absolutely perfect in each tetrachord taken by itself; but that there is some alteration in passing from one tetrachord to the other. This is a new reason for distinguishing the scale into these two tetrachords.

The source of tones major and minor investigated.

54. It may be ascertained by calculation, that in the tetrachord B, 'c', d, e', the interval, or the tone from 'd' to 'e', is a little less than the interval or tone from 'e' to 'd' (BB). In the same manner, in the second tetrachord 'e, f, g, a', which is, as we have proved, perfectly similar to the first, the note from 'g' to 'a' is a little less than the note from 'f' to 'g'. It is for this reason that they distinguish two kinds of tones; the greater tone *, as from 'c' to 'd', from 'f' to 'g', &c; and the lesser †, from 'd' to 'e', from 'g' to 'a', &c.

Greater tone. * See *Interval.*
Lesser tone. † See *Interval.*

CHAP. VI. *The formation of the Diatonic Scale among the Moderns, or the ordinary Gammut.*

The modern scale, how formed.

55. WE have just shown in the preceding chapter, how the scale of the Greeks is formed, B, 'c, d, e, g, a', by means of a fundamental bass composed of three sounds only, F, C, G; but to form the scale 'c, d, e, f, g, a, b,' c, which we use at present, we must necessarily add to the fundamental bass the note D, to form, with these four sounds F, C, G, D, the following fundamental bass:

C, G, C, F, C, G, D, G, C;

See fig. 5.

from whence we deduce the modulation or scale

'c, d, e, f, g, a, b,' c. *See Scale.*

In effect (CC), 'c' in the scale belongs to the harmony of C which corresponds with it in the bass; 'd', which is the second note in the gammut, is included in the harmony of G, the second note of the bass; 'e' the third note of the gammut, is a natural harmonic of C, which is the third sound in the bass, &c.

56. Hence

(z) The proportion of B to 'c' is as $\frac{15}{16}$ to 1, that is to say as 15 to 16; that between 'c' and 'f' is as $\frac{5}{4}$ to $\frac{4}{3}$, that is to say (note Q), as 5 times 3 to 4 times 4, or as 15 to 16: these two proportions then are equal. In the same manner, the proportion of 'e' to 'd' is as 1 to $\frac{8}{9}$, or as 8 to 9; that between 'f' and 'g' is as $\frac{4}{3}$ to $\frac{3}{2}$; that is to say (note Q), as 8 to 9. The proportion of 'e' to 'c' is as $\frac{5}{4}$ to 1, or as 5 to 4; that between 'f' and 'a' is as $\frac{5}{3}$ to $\frac{4}{3}$, or as 5 to 4: the proportions here then are likewise equal.

(AA) The proportion of 'c' to 'c' is as $\frac{5}{4}$ to 1, or as 5 to 4, which is a true third major; that from 'd' to 'b' is as $\frac{9}{8}$ to $\frac{15}{16}$; that is to say, as 9 times 16 to 15 times 8, or as 9 times 2 to 15, or as 6 to 5. In like manner we shall find, that the proportion of 'c' to 'b' is as $\frac{5}{4}$ to $\frac{15}{16}$; that is to say, as 5 times 16 to 15 times 4, or as 4 to 3. which is a true fourth.

(BB) The proportion of 'd' to 'c' is as $\frac{9}{8}$ to 1, or as 9 to 8; that of 'e' to 'd' is as $\frac{5}{4}$ to $\frac{9}{8}$, that is to say, as 40 to 36, or as 10 to 9: now $\frac{10}{9}$ is less removed from unity than $\frac{9}{8}$; the interval then from 'd' to 'e' is a little less than that from 'c' to 'd'.

If any one would wish to know the proportion which $\frac{10}{9}$ bear to $\frac{9}{8}$, he will find (note Q) that it is as 8 times 10 to 9 times 9, that is to say, as 80 to 81. Thus the proportion of a lesser to a greater tone is as 80 to 81; this difference between the greater and lesser tone is what the Greeks called a *comma*.

We may remark, that this difference of a comma is found between the third minor when true and harmonical, and the same chord when it suffers alteration 'd', 'f', of which we have taken notice in the scale (note Y); for we have seen, that this third minor thus altered is in the proportion of 80 to 81 with the true third minor.

(CC) The values or estimates of the notes shall be the same in this as in the former scale, excepting only the tone

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The Greek diatonic scale simpler than ours, and why.

56. Hence it follows, that the diatonic scale of the Greeks is, at least in some respects, more simple than ours; since the scale of the Greeks (chap. v.) may be formed alone from the mode proper to C; whereas ours is originally and primitively formed, not only from the mode of C (F, C, G), but likewise from the mode of G, (C, G, D).

It will likewise appear, that this last scale consists of two parts; of which the one, 'c, d, e, f, g' is in the mode of C; and the other, 'g, a, b,' *c* in that of G.

The note g twice repeated in the diatonic scale from its harmonic relations to the fundamental bass.

57. For this reason the note 'g' is twice repeated in immediate succession in this scale; once as the fifth of C, which corresponds with it in the fundamental bass; and again as the octave of G, which immediately follows G in the same bass. These two consecutive 'g's' are otherwise in perfect unison. For this reason we sing only one of them when we modulate the scale 'c, d, e, f, g, a, b,' *c*; but this does not prevent us from employing a pause or repose, expressed or understood, after the sound 'f'. There is no person who does not perceive this whilst he himself sings the scale.

The modern scale composed of two disjunctive tetrachords. of different modes.

58. The scale of the moderns, then, may be considered as consisting of two tetrachords, disjunctive indeed, but perfectly similar one to the other, 'c, d, e, f', and 'g, a, b, c,' one in the mode of C, the other in that of G. We shall see in the sequel, by what artifice one may cause the scale 'c, d, e, f, g, a, b, c,' to be regarded as belonging to the mode of C alone. For this purpose it is necessary to make some changes in the fundamental bass, which we have already assigned: but this shall be explained at large in chap. xiii.

The mode of G introduced in the fundamental bass productive of conveniences.

59. The introduction of the mode proper to G in the fundamental bass has this happy effect, that the notes 'f, g, a, b,' may immediately succeed each other in ascending the scale, which cannot take place (art. 48.) in the diatonic series of the Greeks, because that series is formed from the mode of C alone. Whence it follows:

1. That we change the mode at every time when we modulate three whole tones in succession.

2. That if these three tunes are sung in succession in the scale 'c, d, e, f, g, a, b,' *c*, this cannot be done but by the assistance of a pause expressed or understood after the note 'f'; insomuch, that the three tones 'fg,' 'ga', 'a b', are supposed to belong to two different tetrachords.

Change of mode the cause of the difficulty in singing three consecutive tones ascending.

60. It ought not then any longer to surprise us, that we feel some difficulty whilst we ascend the scale in singing three tones in succession, because this is impracticable without changing the mode; and if one pauses in the same mode, the fourth sound above the first note will never be higher than a semitone above that which immediately precedes it; as may be seen by 'c, d, e, f,' and by 'g, a, b,' *c*, where there is no more than a semitone between 'e and f', and between 'b' and *c*.

Intervals, though altered in themselves form true consonances with the fundamental bass.

61. We may likewise observe in the scale 'c, d, e, f', that the third minor from 'd' to 'f', is not true, for the reasons which have been already given (art. 49.). It is the same case with the third minor from 'a' to *c*, and with the third major from 'f' to 'a'; but each of these sounds forms otherwise consonances perfectly true, with their corresponding sounds in the fundamental bass.

62. The thirds 'a', *c*, 'f a', which were true in the former scale, are false in this; because in the former scale 'a' was the third of 'f', and here it is the fifth of D, which corresponds with it in the fundamental bass.

Fewer altered consonances in the Greek scale than in ours.

63. Thus it appears, that the scale of the Greeks contains fewer consonances that are altered than ours (DD); and this likewise happens from the introduction of the mode of G into the fundamental bas (EE).

We see likewise that the value of 'a' in the diatonic scale, a value which authors have been divided in ascertaining, solely depends upon the fundamental bass, and that

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tone 'a'; for 'd' being represented by $\frac{9}{8}$, its fifth will be expressed by $\frac{27}{16}$; so that the scale will be numerically signified thus:

$$1 \quad \frac{9}{8} \quad \frac{5}{4} \quad \frac{4}{3} \quad \frac{3}{2} \quad \frac{27}{16} \quad \frac{15}{8} \quad 2$$
$$c, \ d, \ e, \ f, \ g, \ a, \ b, \ c,$$

Where you may see, that the note 'a' of this scale is different from that in the scale of the Greeks; and that the 'a' in the modern series stands in proportion to that of the Greeks as $\frac{27}{16}$ to $\frac{5}{3}$, that is to say, as 81 to 80; these two 'a's' then will likewise differ by a *comma*.

(DD) In the scale of the Greeks, the note 'a' being a third from 'f', there is an altered fifth between 'a' and 'd': but in ours, 'a' being a fifth to 'd', produces two altered thirds, 'f a' and 'a' *c*; and likewise a fifth altered, 'a' *e* as we shall see in the following chapter. Thus there are in our scale two intervals more than in the scale of the Greeks which suffer alteration.

(EE) But here it may be with some colour objected: The scale of the Greeks, it may be said, has a fundamental bass more simple than ours; and, besides, in it there are fewer chords which will not be found exactly true: why then, notwithstanding this, does ours appear more easy to be sung than that of the Greeks? The Grecian scale begins with a semitone, whereas the intonation prompted by nature seems to impel us to rise by a full tone at once. This objection may be thus answered. The scale of the Greeks is indeed better disposed than ours for the simplicity of the bass, but the arrangement of ours is more suitable to natural intonation. Our scale commences by the fundamental sound c, and it is in reality from that sound that we ought to begin; it is from this that all the others naturally arise, and upon this that they depend; nay, if we speak so, in this they are included: on the contrary, neither the scale of the Greeks, nor its fundamental bass, commences with C; but it is from this C that we must depart, in order to regulate our intonation, whether in rising or descending; now, in ascending from 'c', the intonation, even of the Greek scale, gives the series 'c, d, e, f, g, a': and so true is it that the fundamental sound C is here the genuine guide of the ear, that if, before we modulate the sound 'c', we should

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that it must be different according as the note 'a' has 'f' or 'd' for its bass. See the note (CC).

CHAP. VII. *Of Temperament.*

Temperament, why necessary.

64. THE alterations which we have observed in the intervals between particular sounds of the diatonic scale, naturally lead us to speak of temperament. To give a clear idea of this, and to render the necessity of it palpable, let us suppose that we have before us an instrument with keys, a harpsicord, for instance, consisting of several octaves or scales, of which each includes its twelve semitones.

See fig. 6.

Let us choose in that harpsicord one of the strings which will sound the note C, and let us tune the string G to a perfect fifth with C in ascending; let us afterwards tune to a perfect fifth with this G the 'd' which is above it; we shall evidently perceive that this 'd' will be in the scale above that from which we set out: but it is also evident that this 'd' must have in the scale a D which corresponds with it, and which must be tuned a true octave below 'd'; and between 'd' and G there should be the interval of a fifth; so that the D in the first scale will be a true fourth below the G of the same scale. We may afterwards tune the note A of the first scale to a just fifth with this last D; then the note 'e' in the highest scale to a true fifth with this new A, and in consequence the E in the first scale to a true fourth beneath this same A: Having finished this operation, it will be found that the last E, thus tuned, will by no means form a just third major from the sound C (FF): that is to say, that it is impossible for E to constitute at the same time the third major of C and the true fifth of A; or, what is the same thing, the true fourth of A in descending.

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65. If, after having successively and alternately tuned the strings C, G, 'd', A, E, in perfect fifths and fourths one from the other, we continue to tune successively by true fifths and fourths the strings E, B, F♯, C♯, G♯, 'd♯', E♯, B♯; we shall find, that, though B♯, being a semitone higher than the natural note, should be equivalent to 'c' natural, it will by no means form a just octave to the first C in the scale, but be considerably higher (GG); yet this B♯ upon the harpsichord ought not

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should attempt to rise to it by that note in the scale which is most immediately contiguous, we cannot reach it but by the note B, and by the semitone from B to 'c'. Now to make a transition from B to 'c', by this semitone, the ear must of necessity be predisposed for that modulation, and consequently preoccupied with the mode of C: if this were not the case, we should naturally rise from B to 'c♯', and by this operation pass into another mode.

(FF) The A considered as the fifth of D is $\frac{2}{1}\frac{7}{6}$, and the fourth beneath this A will constitute $\frac{3}{4}$ of $\frac{1}{1}\frac{7}{6}$, that is to say, $\frac{8}{6}\frac{1}{4}$; $\frac{8}{6}\frac{1}{4}$ then shall be the value of E, considered as a true fourth from A in descending: now E, considered as the third major of the sound C, is $\frac{5}{4}$, or $\frac{8}{6}\frac{0}{4}$: these two E's then are between themselves in the proportion of 81 to 80; thus it is impossible that E should be at the same time a perfect third major from C, and a true fourth beneath B.

(GG) In effect, if you thus alternately tune the fifth above and the fourth below, in the same octave, you may here see what will be the process of your operation.

C, G, a fifth; D a fourth; A a fifth; E a fourth; B a fifth; F♯ a fourth; C♯ a fifth; G♯ a fourth: 'd♯' a fifth; A♯ a fourth; 'e♯' or 'f♭' a fifth; B♯ a fourth: now it will be found, by a very easy computation, that the first C being represented by 1, G shall be $\frac{3}{2}$, D $\frac{9}{8}$, A $\frac{2}{1}\frac{7}{6}$, E $\frac{8}{6}\frac{1}{4}$, &c. and so of the rest till you arrive at B♯, which will be found $\frac{5}{2}\frac{3}{6}\frac{1}{2}\frac{4}{1}\frac{4}{4}\frac{1}{4}$. This fraction is evidently greater than the number 2, which expresses the perfect octave e to its correspondent C: and the octave below B♯ would be one half of the same fraction, that is to say $\frac{5}{5}\frac{3}{2}\frac{1}{4}\frac{4}{2}\frac{4}{8}\frac{1}{8}$, which is evidently greater than C represented by unity. This last fraction $\frac{5}{5}\frac{3}{2}\frac{1}{4}\frac{4}{2}\frac{4}{8}\frac{1}{8}$ is composed of two numbers; the numerator of the fraction is nothing else but the number 3 multiplied 11 times in succession by itself, and the denominator is the number 2 multiplied 18 times in succession by itself. Now it is evident, that this fraction which expresses the value of B♯, is not equal to the unity which expresses the value of the sound C, though upon the harpsichord, B ♯ and C are identical. This fraction rises above unity by $\frac{7}{5}\frac{1}{2}\frac{2}{4}\frac{5}{8}\frac{3}{8}$, that is say, by about $\frac{1}{7}\frac{}{3}$; and this difference was called the *comma of Pythagoras*. It is palpable that this comma is much more considerable than that which we have already mentioned (note BB), and which is only $\frac{1}{8}\frac{}{0}$.

We have already proved that the series of fifths produces a 'c' different from B♯, the series of thirds major gives another still more different. For, let us suppose this series of thirds, C, E, G♯, B♯, we shall have E equal to $\frac{5}{4}$, G♯ to $\frac{1}{4}\frac{5}{0}$, and B to $\frac{1}{6}\frac{2}{4}\frac{5}{4}$, whose octave below is $\frac{1}{1}\frac{2}{2}\frac{5}{8}$; from whence it appears, that this last B is less than unity (that is to say than C), by $\frac{1}{1}\frac{}{2}\frac{}{8}$, or by $\frac{1}{4}\frac{}{2}$, or near it: A new comma, much greater than the preceding, and which the Greeks have called *apotome major*.

It may be observed, that this B♯, deduced from the series of thirds, is to the B♯ deduced from the series of fifths, as $\frac{1}{1}\frac{2}{2}\frac{5}{8}$ is to $\frac{5}{5}\frac{3}{2}\frac{1}{4}\frac{4}{2}\frac{4}{8}\frac{1}{8}$: that is to say, in multiplying by 524288, as 125 multiplied by 4096 is to 531441, or as 51200 to 531441, that is to say, nearly as 26 is to 27: from whence it may be seen, that these two B's♯ are very considerably different one from the other, and even sufficiently different to make the ear sensible of it; because the difference consists almost of a minor semitone, whose value, as will afterwards be seen (art. 139.), is $\frac{2}{3}\frac{5}{4}$.

Moreover, if, after having found the G♯ equal to $\frac{3}{1}\frac{5}{6}$, we then tune by fifths and by fourths, G♯, 'd♯', A♯, C♯, B♯, as we have done with respect to the first series of fifths, we find that the B♯ must be $\frac{3}{4}\frac{0}{0}\frac{2}{4}\frac{5}{8}$; its difference, then, from unity, or, in other words, from C, is $\frac{2}{1}\frac{3}{0}\frac{}{4}\frac{}{8}$, that is to say, about $\frac{1}{8}\frac{}{9}$; a comma still less than any of the preceding, and which the Greeks have called *apotome minor*.

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not to be different from the octave above C: for every B♯ and every 'c' is the same sound, since the octave or the scale only consists of twelve semitones.

Reasons and rules for temperament.

66. From thence it necessarily follows, 1. That it is impossible that all the octaves and all the fifths should be just at the same time, particularly in instruments which have keys, where no intervals less than a semitone are admitted. 2. That, of consequence, if the fifths are justly tuned, some alteration must be made in the octaves; now the sympathy or sound which subsists between any note and its octave, does not permit us to make such an alteration: this perfect coalescence of sound is the cause why the octave should serve as limits to the other intervals, and that all the notes which rise above or fall below the ordinary scale, are no more than replications, i. e. repetitions, of all that have gone before them. For this reason, if the octave were altered, there could be no longer any fixed point either in harmony or melody. It is then absolutely necessary to tune the 'c' or B♯ in a just octave with the first; from whence it follows, that, in the progression of fifths, or, what is the same thing, in the alternate series of fifths and fourths, C, G, D, A, E, B, F♯, C♯, G♯, 'd♯', A♯, 'e♯', B♯, it is necessary that all the fifths should be altered, or at least some of them. Now, since there is no reason why one should rather be altered than another, it follows, that we ought to alter them all equally. By these means, as the alteration is made to influence all the fifths, it will be in each of them almost imperceptible; and thus the fifth, which, after the octave, is the most perfect of all consonances, and which we are under the necessity of altering, must only be altered in the least degree possible.

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67. It is true, that the thirds will be a little harsh: but as the interval of sounds which constitutes the third, produces a less perfect coalescence than that of the fifth, it is necessary, says M. Rameau, to sacrifice the justice of that chord to the perfection of the fifth; for the more perfect a chord is in its own nature, the more displeasing to the ear is any alteration which can be made in it. In the octave the least alteration is insupportable.

Its definition.

68. This change in the intervals of instruments which have, or even which have not, keys, is that which we call *temperament*.

Principle whence the theory may be deduced.

69. It results then from all that we have now said, that the theory of temperament may be reduced to this question.—The alternate succession of fifths and fourths having been given, (art. 66.), in which B♯ or C is not the true octave of the first C; it is proposed to alter all the fifths equally, in such a manner that the two C's may be in a perfect octave the one to the other.

Practical directions for temperament.

70. For a solution of this question, we must begin with tuning the two C's in a perfect octave the one to the other; in consequence of which, we will render all the semitones which compose the octave as equal as possible. By this means (HH) the alteration made in each

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In a word, if, after having found E equal to $\frac{5}{4}$ in the progression of thirds, we then tune by fifths and fourths E, B, F♯, C♯, &c. we shall arrive at a new B♯, which shall be $\frac{32805}{32768}$, and which will not differ from unity but by about $\frac{1}{885}$, which is the last and smallest of all the commas; but it must be observed, that, in this case, the thirds major from E to G♯, from G♯ to B♯, or C, &c. are extremely false, and greatly altered.

(HH) All the semitones being equal in the temperament proposed by M. Rameau, it follows, that the twelve semitones C, C♯, D, D♯, E, E♯, &c. shall form a continued geometrical progression; that is to say, a series in which C shall be to C♯ in the same proportion as C♯ to D, as D to D♯, &c. and so of the rest.

These twelves semitones are formed by a series of thirteen sounds, of which C and its octave 'c' are the first and last. Thus to find by computation the value of each sound in the temperament, which is the present object of our speculations, our scrutiny is limited to the investigation of eleven other numbers between 1 and 2 which may form with the 1 and the 2 a continued geometrical progression.

However little any one is practised in calculation, he will easily find each of these numbers, or at least a number approaching to its value. These are the characters by which they may be expressed, which mathematicians will easily understand, and which others may neglect.

C	C♯	D	D♯	E	F	F♯	G	G♯
	$\sqrt[12]{\ }$	$\sqrt[12]{\ }$	$\sqrt[12]{\ }$	$\sqrt[12]{\ }$	$\sqrt[12]{\ }$	$\sqrt[12]{\ }$	$\sqrt[12]{\ }$	$\sqrt[12]{\ }$
1	$\sqrt{2}$	$\sqrt{2^2}$	$\sqrt{2^3}$	$\sqrt{2^4}$	$\sqrt{2^5}$	$\sqrt{2^6}$	$\sqrt{2^7}$	$\sqrt{2^8}$
	A	A♯	B	'c'				
	$\sqrt[12]{2^9}$	$\sqrt[12]{2^{10}}$	$\sqrt[12]{2^{11}}$	$\sqrt[12]{2^{12}}$				

It is obvious, that in this temperament all the fifths are equally altered. One may likewise prove, that the alteration of each in particular is very inconsiderable; for it will be found, for instance, that the fifth from C to G, which should be $\frac{3}{2}$, ought to be diminished by about $\frac{1}{12}$ of $\frac{1}{77}$; that is to say, by $\frac{1}{924}$, a quantity almost inconceivably small.

It is true, that the thirds major will be a little more altered; for the third major from C to E, for instance, shall be increased in its interval by about $\frac{1}{100}$: but it is better, according to M. Rameau, that the alteration should fall upon the third than upon the fifth, which after the octave is the most perfect chord, and from the perfection of which we ought never to degenerate but as little as possible.

Besides, it has appeared from the series of thirds major C, E, G♯, B♯, that this last B♯ is very different from 'c' (note GG); from whence it follows, that if we would tune this B♯ in unison with the octave of C, and alter at the same time each of the thirds major by a degree as small as possible, they must all be equally altered. This is what occurred in the temperament which we propose; and if in it the third be more altered than the fifth, it is a consequence of the difference which we find between the degrees of perfection in these intervals; a difference with which, if we may speak so, the temperament proposed conforms itself. Thus this diversity of alteration is rather advantageous than inconvenient.

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each fifth will be very considerable, but equal in all of them.

Rameau's method of temperament proposed.

71. In this, then, the theory of temperament consists: but as it would be difficult in practice to tune a harpsichord or organ by thus rendering all the semitones equal, M. Rameau, in his *Generation Harmonique*, has furnished us with the following method, to alter all the fifths as equally as possible.

72. Take any key of the harpsichord which you please; but let it be towards the middle of the instrument; for instance, C: then tune the note G a fifth above it, at first with as much accuracy as possible; this you may imperceptibly diminish: tune afterwards the fifth to this with equal accuracy, and diminish it in the same manner; and thus proceed from one fifth to another in ascent: and as the ear does not appreciate so exactly sounds that are extremely sharp, it is necessary, when by fifths you have risen to notes extremely high, that you should tune in the most perfect manner the octave below the last fifth which you had immediately formed; then you may continue always in the same manner; till in this process you arrive at the last fifth from E♯ to B♯, which should of themselves be in tune; that is to say, they ought to be in such a state, that B♯, the highest note of the two which compose the fifth, may be identical with the sound C, with which you began, or at least the octave of that sound perfectly just: it will be necessary then to try if this C, or its octave, forms a just fifth with the last sound E♯ or F, which has been already tuned. If this be the case, we may be certain that the harpsichord is properly tuned. But if this last fifth be not true, in this case it will be too sharp, and it is an indication that the other fifths have been too much diminished, or at least some of them; or it will be too flat, and consequently discover that they have not been sufficiently diminished. We must then begin and proceed as formerly, till we find the last fifth in tune of itself, and without our immediate interposition (11).

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(11) We have only to acknowledge, with M. Rameau, that this temperament is far remote from that which is now in practice: it may here be seen in what this last temperament consists as applied to the organ or harpsichord. They begin with C in the middle of the keys, and they flatten the four first fifths G, D, A, E, till they form a true third major from E to C; afterwards, setting out from this E, they tune the fifths B, F♯, C♯, G♯, but flattening them still less than the former, so that G♯ may almost form a true third major with E. When they have arrived at G♯, they stop; they resume the first C, and tune to it the fifth F in descending, then the fifth B♭, &c. and they heighten a little all the fifths till they have arrived at A♭, which ought to be the same with the G♯ already tuned.

If, in the temperament commonly practised, some thirds are found to be less altered than in that prescribed by M. Rameau, in return, the fifths in the first temperament are much more false, and many thirds are likewise so; insomuch, that upon a harpsichord tuned according to the temperament in common use, there are five or six modes which the ear cannot endure, and in which it is impossible to execute any thing. On the contrary, in the temperament suggested by M. Rameau, all the modes are equally perfect; which is a new argument in its favour, since the temperament is peculiarly necessary in passing from one mode to another, without shocking the ear; for instance, from the mode of C to that of G, from the mode of G to that of D, &c. It is true, that this uniformity of modulation will to the greatest number of musicians appear a defect: for they imagine, that, by tuning the semitones of the scale unequal, they give each of the modes a peculiar character; so that, according to them, the scale of C,

C, D, E, F, G, A, B, C,

is not perfectly similar to the gammut or diatonic scale of the mode of E,

E, F♯, G♯, A♯, B, c♯, d♯, e,

which in their judgment, renders the modes of C and E proper for different manners of expression. But after all that we have said in this treatise on the formation of diatonic intervals, every one should be convinced, that, according to the intention of nature, the diatonic scale ought to be perfectly the same in all its modes: The contrary opinion, says M. Rameau, is a mere prejudice of musicians. The character of an air arises chiefly from the intermixture of the modes; from the greater or lesser degrees of vivacity in the movement; from the tones, more or less grave, or more or less acute, which are assigned to the generator of the mode; and from the chords more or less beautiful, as they are more or less deep, more or less flat, more or less sharp, which are found in it.

In short, the last advantage of this temperament is, that it will be found conformed with, or at least very little different from that which is practised upon instruments without keys; as the bass-viol, the violin, in which true fifths and fourths are preferred to thirds and sixths tuned with equal accuracy; a temperament which appears incompatible with that commonly used in tuning the harpsichord.

Yet M. Rameau, in his *New System of Music*, printed in 1726, adopted the ordinary temperament. In that work, (as may be seen chap. xxiv.), he pretends that the alteration of the fifths is much more supportable than that of the thirds major; and that this last interval can hardly suffer a greater alteration than the octave, which, as we know, cannot suffer the slightest alteration. He says, that if three strings are tuned, one by an octave, the other by a fifth, and the next by a third major to a fourth string, and if a sound be produced from the last, the strings tuned by a fifth will vibrate, though a little less true than it ought to have been; but that the octave and the third major, if altered in the least degree, will not vibrate: and he adds, that the temperament which is now practised, is founded upon that principle. M. Rameau goes still farther; and as, in the ordinary temperament,

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By this method all the twelve sounds which compose one of the scales shall be tuned: nothing is necessary but to tune with the greatest possible exactness their octaves in the other scales, and the harpsichord shall be well tuned.

Alterations by either method hardly disagreeable.

We have given this rule for temperament from M. Rameau; and it belongs only to disinterested artists to judge of it. However this question be determined, and whatever kind of temperament may be received, the alteration which it produces in harmony will be but very small, or not perceptible to the ear, whose attention is entirely engrossed in attuning itself with the fundamental bass, and which suffers, without uneasiness, these alterations, or rather takes no notice of them, because it supplies from itself what may be wanting to the truth and perfection of the intervals.

Simple and daily experiments confirm what we now advance. Listen to a voice which is accompanied, in singing, by different instruments; though the temperament of the voice, and the temperament of each of the instruments, are all different one from another, yet you will not be in the least affected with the kind of cacophony which ought to result from these diversities, because the ear supposes these intervals true, of which it does not appreciate differences.

We may give another experiment. Let the three keys E, G, B be struck upon an organ, and the minor perfect chord only will be heard; though E, by the construction of that instrument, must cause G ♯ likewise to be heard; though G should have the same effect upon D, and B upon F ♯; insomuch that the ear is at once affected with all these sounds, D, E, F ♯, G, G ♯, B: how many dissonances perceived at the same time, and what a jarring multitude of discordant sensations, would result from thence to the ear, if the perfect chord with which it is preoccupied had not power entirely to abstract its attention from such sound as might offend!

Chap. VIII. *Of Reposes or Cadences* (kk).

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Cadences perfect and imperfect, what and why.

73. In a fundamental bass whose procedure is by fifths, there always is, or always may be, a *repose*, or crisis, in which the mind acquiesces in its transition from one sound to another: but a repose may be more or less distinctly signified, and of consequence more or less perfect. If one should rise by fifths; if, for instance, we pass from C to G; it is the generator which passes to one of these fifths, and this fifth was already pre-existent in its generator: but the generator exists no longer in this fifth; and the ear, as this generator is the principle of all harmony and of all melody, feels a desire to return to it. Thus the transition from a sound to its fifth in ascent, is termed an *imperfect repose*, or *imperfect cadence*; but the transition from any sound to its fifth in descent, is denominated a *perfect cadence*, or an *absolute repose*: it is the offspring which returns to its generator, and as it were recovers its existence once more in that generator itself, with which when sounding it resounds (chap. i.).

See *Repos* or *Cadence*

Perfect cadences more or less perfect and why.

74. Amongst absolute reposes, there are some, if we may be allowed the expression, more absolute, that is to say, more perfect, than others. Thus in the fundamental bass

C, G, C, F, C, G, D, G, C,

which forms, as we have seen, the diatonic scale of the moderns, there is an absolute repose from D to G, as from G to C; yet this last absolute repose is more perfect than the preceding, because the ear, prepossessed with the mode of C by the multiplied impression of the sound C which it has already heard thrice before, feels a desire to return to the generator C; and it accordingly does so by the absolute repose G C.

Cadence in melody different from what it is in harmony.

75. We may still add, that what is commonly called *cadence* in melody, ought not to be confounded with what we name *cadence* in harmony. In

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temperament, there is a necessity for altering the last thirds major, and to make them a little more sharp, that they may naturally return to the octave of the principal sound, he pretends that this alteration is tolerable, not only because it is almost insensible, but because it is found in modulations not much in use, unless the composer should choose it on purpose to render the expression stronger. "For it is proper to remark (says he), that we receive different impressions from the intervals in proportion to their different alterations: for instance, the third major, which naturally elevates us to joy, in proportion as we feel it, heightens our feelings even to a kind of fury, when it is tuned too sharp; and the third minor, which naturally inspires us with tenderness and serenity, depresses us to melancholy when it is too flat." All this is very different from what this celebrated musician afterwards exhibited in his *Generation Harmonique*, and in the performances which followed it. From this we can only conclude, that the reasons which, after him, we have urged for the new temperament, must without doubt have appeared to him very strong, because in his mind they had superseded those which he had formerly adduced in favour of the ordinary temperament.

We do not pretend to give any decision for either the one or the other of these methods of temperament, each of which appears to us to have its particular advantages. We shall only remark, that the choice of the one or the other must be left absolutely to the taste and inclination of the reader; without, however, admitting this choice to have any influence upon the principles of the system of music, which we have followed even till this period, and which must always subsist, whatever temperament we adopt.

(kk) That the reader may have a clear idea of the term before he enters upon the subject of this chapter, it may be necessary to caution him against a mistake into which he may be too easily led by the ordinary signification of the word *repose*. In music, therefore, it is far from being synonymous with the word *rest*. It is, on the contrary, the termination of a musical *phrase* which ends in a cadence more or less emphatic, as the sentiment implied in the phrase is more or less complete. Thus a repose in music answers the same purpose as punctuation in language. See Repose, in Rousseau's Musical Dictionary.

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In the first case, the word only signifies an agreeable and rapid alteration between two contiguous sounds, called likewise a *trill* or *shake;* in the second, it signifies a repose or close. It is however true, that this shake implies, or at least frequently enough presages, a repose, either present or impending, in the fundamental bass (LL).

Cadences in the fundamental bass necessary in the diatonic scale, and which the most perfect.

76. Since there is a repose in passing from one sound to another in the fundamental bass, there is also a repose in passing from one note to another in the diatonic scale, which is formed from it, and which this bass represents: and as the absolute repose G C is of all others the most perfect in the fundamental bass, the repose from B to 'c', which answers to it in the scale, and which is likewise terminated by the generator, is for that reason the most perfect of all others in the diatonic scale ascending.

Definition and use of a sensible note.

See *Sensible Note.*

77. It is then a law dictated by nature itself that if you would ascend diatonically to the generator of a mode, you can only do this by means of the third major, from the fifth of that very generator. This third major, which with the generator forms a semitone, has for that reason been called the *sensible note* or *leading note*, as introducing the generator, and preparing us for the most perfect repose.

We have already proved, that the fundamental bass is the principle of melody. We shall besides make it appear in the sequel, that the effect of a repose in melody arises solely from the fundamental bass.

CHAP. IX. *Of the Minor Mode and its Diatonic Series.*

The diatonic series of the minor mode ascertained by different examples.

78. IN the second chapter, we have explained (art. 20. 30. 31. and 32.) by what means, and upon what principle, the minor chord C, E♭, G, 'c' may be formed, which is the characteristical chord of the minor mode. Now what we have there said, taking C for the principal and fundamental sound, we might likewise have said of any other note in the scale, assumed in the same manner as the principal and fundamental sound: but as in the minor chord, C, E♭, G, 'c' there occurs an E♭ which is not found in the ordinary diatonic scale, we shall immediately substitute, for greater ease and conveniency, another chord, which is likewise minor and exactly similar to the former, of which all the notes are found in the scale.

79. The scale affords us three chords of this kind, viz. D, F, A, 'd'; A, 'c, e, a'; and E, G, B, 'e'. Among these three we shall choose A, 'c, e, a'; because this chord, without including any sharp or flat, has two sounds in common with the major chord C, E, G, 'c'; and besides, one of these two sounds is the very same 'c': so that this chord appears to have the most immediate, and at the same time the most simple, relation with the chord C, E, G, 'c.' Concerning this we need only add, that this preference of the chord A, 'c, e, a', to every other minor chord, is by no means in itself necessary for what we have to say in this chapter upon the diatonic scale of the minor mode. We might in the same manner have chosen any other minor chord; and it is only, as we have said, for greater ease and conveniency that we fix upon this.

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Tonic or key in harmony, what. See *Principal.*

80. In every mode, whether major or minor, the *principal* sound which implies the perfect chord, whether major or minor, is called the *tonic note* or *key;* thus C is the key in its proper mode, A in the mode of A, &c. Having laid down this principle,

See *Tonic.*

The formation of the scale pursued.

See fig. 4.

81. We have shown how the three sounds, F, C, G, which constitute (art. 38.) the mode of C, of which the first, F, and the last, G, are the two fifths of C, one descending, the other rising, produce the scale, B, 'c, d, e, f, g, a', of the major mode, by means of the fundamental bass G, C, G, C, F, C, F; let us in the same manner take the three sounds D, A, E, which constitute the mode of A, for the same reason that the sounds F, C, G, constitute the mode of C; and of them let us form this fundamental bass, perfectly like the preceding E, A, F, A, D, A, D; let us afterwards place

See fig. 7.

below each of these sounds one of their harmonies, as we have done (chap. v.), for the first scale of the major mode; with this difference, that we must suppose D, and A as implying their thirds minor in the fundamental bass to characterize the minor mode; and we shall have the diatonic scale of that mode,

G♯, A, B, 'c, d, e, f'.

82. The G♯, which corresponds with E in the fundamental bass, forms a third major with that E, though the mode be minor; for the same reason that a third from the fifth of the fundamental sound ought to be major (art. 77.) when the third rises to the fundamental sound A.

See *Imply* or *Carry.*

83. It is true, that, in causing E to imply its third minor G, one might also rise to A by a diatonic progress. But that manner of rising to A would be less perfect than the preceding; for this reason (art. 76.), that the absolute repose or perfect cadence E, A, in the fundamental bass, ought to be represented in the most perfect manner in the two notes of the diatonic scale which answer to it, especially when one of these two notes is A, the key itself upon which the repose is made. From whence it follows, that the preceding note G ought rather to be sharp than natural; because G♯, being included in E (art. 19.), much more perfectly represents the note E in the bass, than the natural G could do, which is not included in E.

Diversities in the scales of the major and minor mode.

84. We may remark this first difference between the scale

G♯, A, B, 'c, d, e, f',

and the scale which corresponds with it in the major mode

B, 'c, d, e, f, g, a',

that from 'c' to 'f' which are the two last notes of the former scale, there is only a semitone; whereas from 'g' to 'a', which are the two last sounds of the latter series, there is the interval of a complete tone; but this not the only discrimination which may be found between the scales of the two modes.

(LL) M. Rousseau, in his letter on French music, has called this alternate undulation of different sounds a *trill*, from the Italian word *trillo*, which signifies the same thing; and some French musicians already appear to have adopted this expression.

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Investigation of these differences and their reasons. See fig. 5.

85. To investigate these differences, and to discover the reason for which they happen, we shall begin by forming a new diatonic scale of the minor mode, similar to the second scale of the major mode,

'c, d, e, f, g, g, a, b', *c*.

That last series, as we have seen, was formed by means of the fundamental bass F, C, G, D, disposed in this manner,

C, G, C, F, C, G, D, G, C.

Let us take in the same manner the fundamental bass D, A, E, B, and arrange it in the following order,

A, E, A, D, A, E, B, E, A,

See fig. 8. and it will produce the scale immediately subjoined,

A, B, 'c, d, e, e, f♯, g♯, a',

in which 'c' forms a third minor with A, which in the fundamental bass corresponds with it, which denominates the minor mode; and, on the contrary, 'g♯' forms a third major with E in the fundamental bass, because 'g♯' rises towards 'a' (art. 82. 83.).

86. We see besides an 'f♯', which does not occur in the former,

G♯, A, B, 'c, d, e, f',

where 'f' is natural. It is because, in the first scale, 'f' is a third minor from D in the bass; and in the second, 'f♯' is the fifth from B in the bass (MM).

Difference between the two scales of the minor mode greater than those of the major.

87. Thus the two scales of the minor mode are still in this respect more different one from the other than the two scales of the major mode; for we do not remark this difference of a semitone between the two scales of the major mode. We have only observed (art. 63.) some difference in the value of A as it stands in each of these scales, but this amounts to much less than a semitone.

'f' and 'g' sharp in the minor mode, and why.

88. From thence it may be seen why 'f' and 'g' are sharp when ascending in the minor mode; besides the 'f' is only natural in the first scale G♯, A, B, 'c, d, e, 'f', because this 'f' cannot rise to 'g♯', (art. 48.).

The case different in descending, and why.

89. It is not the same case in descending. For E, the fifth of the generator, ought not to imply the third major 'g♯', but in the case when that E descends to the generator A to form a perfect repose (art. 77. and 83.); and in this case the third major 'g♯' rises to the generator 'a': but the fundamental bass AE may, in descending, give the scale 'a, g', natural, provided 'g' does not rise again to 'a'.

Explication of the descending scale in the minor mode from a fundamental bass difficult.

90. It is much more difficult to explain how the 'f' which ought to follow this 'g' in descending, is natural and not sharp; for the fundamental bass

A, E, B, E, A, D, A, E, A,

produces in descending,

'a, g, f♯, e, e, d, c', B, A.

And it is plain that the 'f' cannot be otherwise than sharp, since 'f♯' is the fifth of the note B of the fundamental bass. Experience, however, evinces that the 'f' is natural in descending in the diatonic scale of the major mode of A, especially when the preceding 'g' is natural: and it must be acknowledged, that here the fundamental bass appears defective. Theory of Harmony.

Rameau's solution, though the only one, yet unsatisfactory.

M. Rameau has attempted the following solution of this difficulty. In the diatonic scale of the minor mode in descending, ('a, g, f, e, d, c', B, A,) 'g' may be regarded simply as a note of passage, merely added to give sweetness to the modulation, and as a diatonic gradation by which we may descend to 'f' natural. This is easily perceived, according to M. Rameau, by the fundamental bass,

A, D, A, D, A, E, A,

which produces

'a, f, e, d, c', B, A;

which may be regarded, as he says, as the real scale of the minor mode in descending; to which is added 'g' natural between 'a' and 'f', to preserve the diatonic order.

This appears the only possible answer to the difficulty above proposed: but we know not whether it will fully satisfy the reader; whether he will not see with regret, that the fundamental bass does not produce, to speak properly, the diatonic scale of the minor mode in descent, when at the same time this same bass so happily produces the diatonic scale of that identical mode in ascending, and the diatonic scale of the major mode whether in rising or descending (NN).

CHAP. X. *Of Relative Modes.*

Modes relative, what. See *Mode.*

91. Two modes of such a nature that we can pass from the one to the other, are called *relative modes*. Thus the major mode of C is relative to the major mode of F and to that of G. It has also been seen how many intimate connexions there are between the major mode of C, and the minor mode of A. For, 1. The perfect chords, one major, C, E, G, 'c', the other minor, A, 'c, e, a', which characterize each of those two kinds of modulation * or harmony, have two sounds in common, 'c' and 'e'. 2. The scale of the minor mode of A in descent, absolutely contains the same sounds with the scale of the major mode of C.

* See *Modulation.*

Hence the transition is so natural and easy from the major mode of C to the minor mode of A, or from the minor mode of A to the major mode of C, as experience proves.

92. In the minor mode of E, the minor perfect chord E, G, B, 'e', which characterizes it, has likewise two sounds, E, G, in common with the perfect chord major C, E, G, 'c', which characterizes the major mode of

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(MM) Besides, without appealing to the proof of the fundamental bass, 'f♯' obviously presents itself as the sixth note of this scale; because the seventh note being necessarily 'g♯' (art. 77.) if the sixth were not 'f♯', but 'f♮', there would be an interval of three semitones between the sixth and the seventh, consequently the scale would not be diatonic, (art. 8.).

(NN) When 'g' is said to be natural in descending the diatonic scale of the minor mode of A, it is only meant that this 'g' is not necessarily sharp in descending as it is in rising; for it may be sharp, as may be proved by numberless examples, of which all musical compositions are full. It is true, that, when 'g' is found sharp in descending to the minor mode of A, we are not sure that the mode is minor till the 'f' or 'c' natural is found; both of which impress a peculiar character on the minor mode, viz. 'c' natural, in rising and in descending, and the 'f' natural in descending.

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of C. But the minor mode of E is not so closely related nor allied to the major mode of C as the minor mode of A; because the diatonic scale of the minor mode of E in descent, has not, like the series of the minor mode of A, all these sounds in common with the scale of C. In reality, this scale is 'e, d, c♯, B, A, G, F𝄪, E, where there occurs an 'f' sharp which is not in the scale of C. Though the minor mode of E is thus less relative to the major mode of C than that of A; yet the artist does not hesitate sometimes to pass immediately from the one to the other.

When we pass from one mode to another by the interval of a third, whether in descending or rising, as from C to A, or from A to C, from C to E, or from E to C, the major mode becomes minor, or the minor mode becomes major.

93. There is still another minor mode, into which an immediate transition may be made in issuing from the major mode of C. It is the minor mode of C itself in which the perfect minor chord C, E♭, G, 'c', has two sounds, C and G, in common with the perfect major chord C, E, G, 'c'. Nor is there any thing more common than a transition from the major mode of C to the minor mode, or from the minor to the major (oo).

Chap. XI. *Of Dissonance.*

Cases in which the mode is uncertain.

94. We have already observed, that the mode of C (F, C, G,) has two sounds in common with the mode of G (C, G, D); and two sounds in common with the mode of F (B♭, F, C); of consequence, this procedure of the bass C G may belong to the mode of C, or to the mode of G, as the procedure of the bass F C, or C F, may belong to the mode of C or the mode of F. When one therefore passes from C to F or to G in a fundamental bass, he is still ignorant what mode he is in. It would be, however, advantageous to know it, and to be able by some means to distinguish the generator from its fifths.

How we may investigate the generator and its fifths, and by that means determine the mode.

95. This advantage may be obtained by uniting at the same time the sounds G and F in the same harmony, that is to say, by joining to the harmony G, B, 'd' of the fifth G, the other fifth F in this manner, G, B, 'd, f'; this 'f' which is added, forms a dissonance with G (art. 18.). Hence the chord G, B, 'd, f', is called a *dissonant* chord, or a chord of the seventh. It serves to distinguish the fifth G from the generator C, which always implies, without mixture or alteration, the perfect chord C, E, G, 'c' resulting from nature itself (art. 32.). By this we may see, that when we pass from C to G, one passes at the same time from C to F, because 'f' is found to be comprehended in the chord of G; and the mode of C by these means plainly appears to be determined, because there is none but that mode to which the sounds F and G at once belong. Theory of Harmony.

Manner of treating dissonances continued.

96. Let us now see what may be added to the harmony F, A, C, of the fifth F *below* the generator, to distinguish this harmony from that of the generator. It seems probable at first, that we should add to it the other fifth G, so that the generator C, in passing to F, may at the same time pass to G, and that by this the mode should be determined: but this introduction of G, in the chord F, A, C, would produce two seconds in succession, F G, G A, that is to say, two dissonances whose union would prove extremely harsh to the ear; an inconvenience to be avoided. For if, to distinguish the mode, we should alter the harmony of the fifth F in the fundamental bass, it must only be altered in the least degree possible.

Chord of the great sixth.

97. For this reason, instead of G, we shall take its fifth 'd', the sound that approaches it the nearest, and we shall have, instead of the fifth F, the chord F, A, 'c, d', which is called a *chord of the great sixth.*

One may here remark the analogy there is observed between the harmony of the fifth G and that of the fifth F.

The subject of dissonances continued.

98. The fifth G, in rising above the generator, gives a chord entirely consisting of thirds ascending from G, C, B, 'd, f'; now the fifth F being below the generator C in descending, we shall find, as we go lower by thirds from 'c' towards E, the same sounds 'c', A, F, D, which form the chord F, A, 'c, d', given to the fifth F.

99. It appears besides, that the alteration of the harmony in the two fifths consists only in the third minor D, F, which was reciprocally added to the harmony of these two fifths.

Chap. XII. *Of the Double Use or Employment of Dissonance.*

Account of the double employment.

† See *Inverted.*

100. It is evident by the resemblance of sounds to their octaves, that the chord F, A, 'c, d', is in effect the same as the chord D, F, A, 'c', taken inversely †, that the inverse of the chord C, A, F, D, has been found (art. 98.) in descending by thirds, from the generator C (pp).

101. The

(oo) There are likewise other minor modes, into which we may pass in our egress from the mode major of C; as that of F minor, in which the perfect minor chord F, A♭, 'c', includes the sound 'c', and whose scale in ascent F, G, A♭, B♭, 'c, d, e, f', only includes the two sounds A♭, B♭, which do not occur in the scale of C. This transition, however, is not frequent.

The minor mode of D has only in its scale ascending D, E, F, G, A, B, 'c𝄪, d', one 'c' sharp which is not found in the scale of C. For this reason a transition may likewise be made, without grating the ear, from the mode of C major to the mode of D minor; but this passage is less immediate than the former, because the chords C, E, G, 'c', and D, F, A, 'd', not having a single sound in common, one cannot (art. 37.) pass immediately from the one to the other.

(pp) M. Rameau, in several passages of his works (for instance, in p. 110, 111, 112, and 113. of the *Generation Harmonique*), appears to consider the chord D, F, A, C, as the primary chord and generator of the chord E, A, 'c, d', which is that chord reversed; in other passages (particularly in p. 116. of the same performance), he seems to consider the first of these chords as nothing else but the reverse of the second. It would seem that this

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Difference between dominant and tonic dominant.

101. The chord D, F, A, 'c', is a chord of the seventh like the chord G, B, 'd, f'; with this only difference, that the latter in the third G, B, is major: whereas in the former, the third D, F, is minor. If the F were sharp, the chord D, F♯, A, 'c', would be a genuine chord of the dominant, like the chord G, B, D, 'f'; and as the dominant G may descend to C in the fundamental bass, the dominant D implying or carrying with it the third major F♯ might in the same manner descend to G.

102. Now if the F♯ should be changed into F natural, D, the fundamental tone of this chord D, F, A, 'c', might still descend to G; for the change from F♯ to F natural will have no other effect, than to preserve the impression of the mode of C, instead of that of the mode of G, which the F♯ would have here introduced. The note D will, however, preserve its character as a dominant, on account of the mode of C, which forms a seventh. Thus in the chord of which we treat (D, F, A, 'c'), D may be considered as an *imperfect dominant:* we call it *imperfect*, because it carries with it the third minor F, instead of the third major F♯. It is for this reason that in the sequel we shall call it simply the *dominant*, to distinguish it from the dominant G, which shall be named the *tonic dominant* †.

† See *Dominant.*

103. Thus the sounds F and G, which cannot succeed each other (art. 36.) in a diatonic bass, when they only carry with them the perfect chords F A C, G B 'd', may succeed one another, if 'd' be added to the harmony of the first, and 'f' to the harmony of the second; and if the first chord be inverted, that is to say, if the two chords take this form, D, F, A, C, G, B, 'd, a'.

Seeming contradictions reconciled.

104. Besides, the chord F, A, 'c, d', being allowed to succeed the perfect chord C, E, G, 'c', it follows for the same reasons, that the chord C, E, G, C may be succeeded by D, F, A, 'c'; which is not contradictory to what we have above said (art. 37.), that the sounds C and D cannot succeed one another in the fundamental bass: for in the passage quoted, we had supposed that both C and D carried with them a perfect chord major; whereas, in the present case, D carries the third minor E, and likewise the sound 'c', by which the chord D F A 'c' is connected with that which precedes it C E G 'c'; and in which the sound 'c' is found. Besides, this chord, D F A 'c', is properly nothing else but the chord F A 'c d' inverted, and if we may speak so, disguised.

105. This manner of presenting the chord of the subdominant under two different forms, and of employing it under these two different forms has been called by M. Rameau its *double office* or *employment* †. This is the source of one of the finest varieties in harmony; and we shall see in the following chapter the advantages which result from it.

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Double employment, what, and why so called.

We may add, that as this double employment is a kind of license, it ought not to be practised without some precaution. We have lately seen that the chords D F A 'c', considered as the inverse of F A 'c d,' may succeed to C E G 'c', but this liberty is not reciprocal: and though the chord F A 'c d' may be followed by the chord C E G 'c', we have no right to conclude from thence that the chord D F A 'c', considered as the inverse of F A 'c d', may be followed by the chord C E G 'c'. For this the reason shall be given in chap. xvi.

† See *Double Employment.*

Chap. XIII. *Concerning the Use of this Double Employment, and its Rules.*

By the double use of the above-mentioned chord, the impression of the mode may be preserved.

106. We have shown (chap. xvi.) how the diatonic scale, or ordinary gammut, may be formed from the fundamental bass F, C, G, D, by twice repeating the note G in that series; so that this gammut is primitively composed of two similar tetrachords, one in the mode of C, the other in that of G. Now it is possible, by means of this double employment, to preserve the impression of the mode of C through the whole extent of the scale, without twice repeating the note C, or even without supposing this repetition. For this effect we form the following fundamental bass,

C, G, C, F, C, D, G, C:

in which C is understood to carry with it the perfect chord C E G 'c'; G, the chord G B 'd f'; F the chord F A 'c d'; and D, the chord D F A 'c'. It is plain from what has been said in the preceding chapter, that in this case C may ascend to D in the fundamental bass, and D descend to G, and that the impression of the mode of C is preserved by the 'f' natural, which forms the third minor 'd f', instead of the third major which D ought naturally to imply.

107. This fundamental bass will give, as it is evident, the ordinary diatonic scale,

'c, d, e, f, g, a, b', *c*,

which of consequence will be in the mode of C alone; and if one should choose to have the second tetrachord in the mode of G, it will be necessary to substitute 'f♯' instead of 'f♮', in the harmony of D (qq).

108. Thus the generator C may be followed according

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this great artist has neither expressed himself upon this subject with so much uniformity nor with so much precision as is required. We think that there is some foundation for considering the chord F, A, 'c, d', as primitive: 1. Because in this chord, the fundamental and principal note is the subdominant F, which ought in effect to be the fundamental and principal sound in the chord of the sub-dominant. 2. Because that without having recourse, with M. Rameau, to harmonical and arithmetical progressions, of which the consideration appears to us quite foreign to the question, we have found a probable and even a satisfactory reason for adding the note 'd' to the harmony of the fifth F (art. 96. and 97.). The origin thus assigned for the chord of the sub-dominant appears to us the most natural, though M. Rameau does not appear to have felt its full value; for scarcely has it been slightly insinuated by him.

(qq) It is obvious that this fundamental bass C, G, C, F, C, D, G, C, which formed the ascending scale 'c, d, e, f, g, a, b', *c*, cannot by inverting it, and taking it inversely in this manner, C, G, D, C, F, C, G, C, form the diatonic scale *c*, 'b, a, g, f, e, d, c', in descent. In reality, from the chord G, B, 'd, f', we cannot pass to the chord D, F, A, 'c', nor from thence to C, E, G, 'c'. For this reason, in order to have the fundamental

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ing to pleasure in ascending diatonically either by a tonic dominant (D F♯ A C), or by a simple dominant (D F A C).

109. In the minor mode of A, the tonic dominant E ought always to imply its third major E G♯, when this dominant E descends to the generator A (art. 83.); and the chord of this dominant shall be E G♯ B 'd', entirely similar to G B 'd f'. With respect to the sub-dominant D, it will immediately imply the third minor F, to denominate the minor mode; and we may add B above its chord D F A, in this manner D F A B, a chord similar to that of F A 'c d'; and as we have deduced from the chord F A 'c d' that of D F A 'c', we may in the same manner deduce from the chord D F A B 'a' a new chord of the seventh B 'd f a', which will exhibit the *double employment of dissonances* in the minor mode.

110. One may employ this chord B 'd f a', to preserve the impression of the mode of A in the diatonic scale of the minor mode, and to prevent the necessity of twice repeating the sound E; but in this case, the F must be rendered sharp, and the chord changed to B 'd f♯ a', the fifth of B being 'f'♯, as we have seen above. This chord is then the inverse of D F♯ A B, the sub-dominant implying the third major, which ought not to surprise us; for in the minor mode of A, the second tetrachord E F♯ G♯ A is exactly the same as it would be in the major mode of A: Now, in the major mode of A the subdominant D ought to imply the third major F♯.

Diversities in the minor mode more numerous than in the major.

111. Hence the minor mode is susceptible of a much greater number of varieties than the major: the major mode is found in nature alone; whereas the minor is in some measure the product of art. But, in return, the major mode has received from nature, to which it owes its immediate formation, a force and energy which the minor cannot boast.

Chap. XIV. *Of the different Kinds of Chords of the Seventh.*

Investigation whether art, in consequence of some successful advances, may not be carried farther.

112. The dissonance added to the chord of the dominant and of the sub-dominant, though in some measure suggested by nature (chap. xi.), is nevertheless a work of art; but as it produces great beauties in harmony by the variety which it introduces into it, let us discover whether, in consequence of this first advance, art may not still be carried farther. Theory of Harmony.

113. We have already three different kinds of chords of the seventh, viz.

1. The chord G B 'd f', composed of a third major followed by two thirds minor.

2. The chord D F A 'c', or B 'd f♯ a', a third major between two minors.

3. The chord B 'd f a', two thirds minor followed by a major.

114. There are still two other kinds of chords of the seventh which are employed in harmony; one is composed of a third minor between two thirds major, C E G B, or F A 'c c'; the other is wholly composed of thirds minor G♯ B 'd f'. These two chords, which at first appear as if they ought not to enter into harmony if we rigorously keep to the preceding rules, are nevertheless frequently practised with success in the fundamental bass. The reason is this:

The chords last described admissible, and why.

115. According to what has been said above, if we would add a seventh to the chord C E G, to make a dominant of C, one can add nothing but B♭; and in this case C E G B♭ would be the chord of the tonic dominant in the mode of F, as G B 'd f' is the chord of the tonic dominant in the mode of C; but if we would preserve the impression of the mode of C in the harmony, we change this B♭ into B natural, and the chord C E G B♭ becomes C E G B. It is the same case with the chord F A 'c e', which is nothing else but the chord F A 'c e♭'; in which one may substitute for 'e♭', 'e' natural, to preserve the impression of the mode of C, or that of F.

Besides, in such chords as C E G B, F A 'c c', the founds B and 'e', though they form a dissonance with C in the first case, and with F in the second, are nevertheless supportable to the ear, because these sounds B and 'c' (art. 19.) are already contained and understood, the first in the note E of the chord C E G B, as likewise in the note G of the same chord; the second in the note A of the chord F A 'c e', as likewise in the note 'c' of the same chord. All together then seem to allow the artist to introduce the note B and 'e' into these two chords (RR).

Chords of the seventh continued and explained.

116. With respect to the chord of the seventh G♯ B 'd f', wholly composed of thirds minor, it may be regarded as formed from the union of the two chords of the

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bass of the scale, c, 'b, a, g, f, e, d, c', in descent, we must either determine to invert the fundamental bass mentioned in art. 55. in this manner, C, G, D, G, C, F, C, G, C, in which the second G and the second C answer to the G alone in the scale; or otherwise we must form the fundamental bass C, G, D, G, C, G, C, in which all the notes imply perfect chords major, except the second G, which implies the chord of the seventh G, B, 'd, f', and which answers to the two notes of the scale G, F, both comprehended in the chord G, B, 'd, f'.

Different chords of the seventh.

Whichever of these two basses we shall choose, it is obvious that neither the one nor the other shall be wholly in the mode of C, but in the mode of C and in that of G. Whence it follows, that the double employment which gives to the scale a fundamental bass all in the same mode when ascending, cannot do the same in descending; and that the fundamental bass of the scale in descending will be necessarily in two different modes.

(RR) On the contrary, a chord such as C E♭ G B, in which E would be flat, could not be admitted in harmony, because in this chord the B is not included and understood in E♭. It is the same case with several other chords, such as B D F A♯, B D♯ F A, &c. It is true, that in the last of these chords, A is included in F, but it is not contained in D♯; and this D♯ likewise forms with F and with A a double dissonance, which, joined with the dissonance B F, would necessarily render this chord not very pleasing to the ear; we shall yet, however, see in the second part, that this chord is sometimes used.

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the dominant and of the sub-dominant in the minor mode. In effect, in the minor mode of A, for instance, these two chords are E G♯ B, 'd', and D E A B, whose union produces E G♯ B, 'd, f, a'. Now, if we should suffer this chord to remain thus, it would be disagreeable to the ear, by its multiplicity of dissonances, D E, E F, F G♯, A B, D G♯, (art. 18.); so that, to avoid this inconveniency, the generator A is immediately expunged, which, (art. 19.) is as it were understood in D, and the fifth or dominant E, whose place the sensible note D♯ is supposed to hold: thus there remains only the chord G♯ B 'd f', wholly composed of thirds minor, and in which the dominant E is considered as understood: in such a manner that the chord G♯ B 'd f' represents the chord of the tonic dominant E G♯ B 'd', to which we have joined the chord of the sub-dominant D F A B, but in which the dominant E is always reckoned the principal note (ss).

117. Since, then, from the chord E G♯ B 'd', we may pass to the perfect A C 'e a', and *vice versa*, we may in like manner pass from the chord G♯ B 'd f' to the chord A C 'e a', and from this last to the chord G♯ B 'd f': this remark will be very useful to us in the sequel.

Chap. XV. *Of the* Preparation *of Discords.*

Dissonance, what.

118. In every chord of the seventh, the highest note, that is to say, the seventh above the fundamental, is called a *dissonance* or *discord;* thus 'f' is the dissonance of the chord G B 'd f'; 'c' in the chord D F A 'c', &c.

Manner of preparing dissonances investigated.

119. When the chord G B 'd f' follows the chord C E G 'c', as often happens, it is obvious that we do not find the dissonance 'f' in the preceding chord C E G 'c'. Nor ought it indeed to be found in that chord; for this dissonance is nothing else but the sub-dominant added to the harmony of the dominant to determine the mode: now, the sub-dominant is not found in the harmony of the generator.

120. For the same reason, when the chord of the sub-dominant F A 'c d' follows the chord C E G 'c', the note 'd', which forms a dissonance with 'c', is not found in the preceding chord.

It is not so when the chord D F A 'c' follows the chord C E G 'c'; for 'c' which forms a dissonance in the second chord, stands as a consonance in the preceding.

Dissonance is only tolerable to the ear when found in preceding chords.

121. In general, dissonance being the production of art (chap. xi.), especially in such chords as are not of the tonic dominant nor sub-dominant, the only means to prevent its displeasing the ear by appearing too heterogeneous to the chord, is, that it may be, if we may speak so, announced to the ear by being found in the preceding chord, and by that means connect the two chords. Hence follows this rule:

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Preparation of dissonances how performed

122. In every chord of the seventh, which is not the chord of the tonic dominant, that is to say, (art. 102.) which is not composed of a third major followed by two thirds minor, the dissonance which this chord forms ought to stand as a consonance in the chord which precedes it.

This is what we call a *prepared dissonance.*

See *Preparation.*

123. Hence, in order to prepare a dissonance, the fundamental bass must necessarily ascend by the interval of a second, as

C E G 'c', D F A 'c';

or descend by a third, as

C E G 'c', A C E G;

or descend by a fifth, as

C E G 'c', F A C E:

in every other case the dissonance cannot be prepared. This may be easily ascertained. If, for instance, the fundamental bass rises by a third, as C E G 'c', E G B 'd', the dissonance 'd' is not found in the chord C E G 'c'. The same might be said of C E G 'c', G B 'd f', and C E G 'c', B D 'f a', in which the fundamental bass rises by a fifth or descends by a second.

124. When a tonic, that is to say, a note which carries with it a perfect chord, is followed by a dominant in the interval of a fifth or third, this succession may be regarded as a process from that same tonic to another, which has been rendered a dominant by the addition of the dissonance.

Moreover, we have seen (art. 119. and 120.) that a dissonance does not require preparation in the chords of the tonic dominant and of the sub-dominant: whence it follows, that every tonic carrying with it a perfect chord, may be changed into a tonic dominant (if the perfect chord be major), or into a sub-dominant (whether the chord be major or minor) by adding the dissonance all at once.

Chap. XVI. *Of the Rules for* resolving *Dissonances.*

Dissonances to be resolved, must be disguised and made to appear in the character of harmonies

125. We have seen (chap. v. and vi.) how the diatonic scale, so natural to the voice, is formed by the harmonics of fundamental sounds; from whence it follows, that the most natural succession of harmonical sounds is to be diatonic. To give a dissonance then, in some measure, as much the character of an harmonic sound as may be possible, it is necessary that this dissonance, in that part of the modulation where it is found, should descend or rise diatonically upon another note, which may be one of the consonances of the subsequent chord.

126. Now in the chord of the tonic dominant it ought

In the chord of the tonic dominant, the dissonance should rather rise than descend, and why.

(ss) We have seen (art. 109.) that the chord B 'd f a', in the minor mode of A, may be regarded as the inverse of the chord D F A B; it would likewise seem, that, in certain cases, this chord B 'd f a' may be considered as composed of the two chords F B 'd f', F A 'c d' of the dominant and of the sub-dominant of the major mode of C; which chords may be joined together after having excluded from them, 1. The dominant G, represented by its third major B, which is presumed to retain its place. 2. The note C which is understood in F, which will form this chord B 'd f a'. The chord B 'd f a', considered in this point of view, may be understood as belonging to the major mode of C upon certain occasions.

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ought rather to descend than to rise; for this reason. Let us take, for instance, the chord G B 'd f' followed by the chord C E G 'c'; the part which formed the dissonance 'f' ought to descend to 'e' rather than rise to 'g', though both the sounds E and G are found in the subsequent chord C E G 'c'; because it is more natural and more conformed to the connexion which ought to be found in every part of the music, that G should be found in the same part where G has already been sounded, whilst the other part was sounding 'f', as may be here seen (Parts First and Fourth).

First part,	'f'	'e'
Second,	'd'	'c'
Third,	B	
Fourth,	G	G
Fundamental bass,	G	C

Consequences of the former rule.

127. So, in the chord of the simple dominant DFA 'e', followed by G B 'd f', the dissonance 'e' ought rather to descend to B than rise to 'd'.

Another consequence.

128. And, for the same reason, in the chord of the sub-dominant F A 'c d', the dissonance 'd' ought to rise to 'e' of the following chord C E G 'c, rather than descend to 'c'; whence may be deduced the following rules.

But is deduced from the former propositions.

129. 1°, In every chord of the dominant, whether tonic or simple, the note which constitutes the seventh, that is to say the dissonance, ought diatonically to descend upon one of the notes which form a consonance in the subsequent chord.

2°, In every chord of the sub-dominant, the dissonance ought to rise diatonically upon the third of the subsequent chord.

Dissonance resolved, what. See *Resolution.*

130. A dissonance which descends or rises diatonically according to these two rules, is called a *dissonance resolved.*

From these rules it is a necessary result, that the chord of the seventh D F A 'e', though it should even be considered as the inverse of F A 'c d', cannot be succeeded by the chord C E G 'c', since there is not in this last chord the note B, upon which the dissonance 'e' of the chord D F A 'e' can descend.

One may besides find another reason for this rule, in examining the nature of the double employment of dissonances. In effect, in order to pass from D F A 'e', to C E G 'c', it is necessary that D F A 'e' should in this case be understood as the inverse of F A 'c d.' Now the chord D F A 'e' can only be conceived as the inverse of F A 'c d', when this chord D F A 'e' precedes or immediately follows the C E G 'c'; in every other case the chord D F A 'e' is a primitive chord, formed from the perfect minor chord D F A, to which the dissonance 'e' was added, to take from D the character of a tonic. Thus the chord D F A 'e', could not be followed by the chord C E G 'c', but after having been preceded by the same chord. Now, in this case, the *double employment* would be entirely a futile expedient, without producing any agreeable effect: because, instead of this succession of chords, C E G 'c', D F A 'e', C E G 'c', it would be much more easy and natural to substitute this other, which furnishes this natural succession C E G 'c', F A 'c d', C E G 'c'. The proper use of the double employment is, that, by means of inverting the chord of the sub-dominant, it may be able to pass from that chord thus inverted to any other chord except that of the tonic, to which it naturally leads.

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Chap. XVII. *Of the Broken or Interrupted Cadence.*

The test of perfection in cadences to be found in the fundamental bass.

131. In a fundamental bass which moves by fifths, there is always, as we have formerly observed (chap. viii.), a repose more or less perfect from one sound to another; and of consequence there must likewise be a repose more or less perfect from one sound to another in the diatonic scale, which results from that bass.—It may be demonstrated by a very simple experiment, that the cause of a repose in melody is solely in the fundamental bass expressed or understood. Let any person sing these three notes 'e d g', performing on the 'd' a shake, which is commonly called a *cadence;* the modulation will appear to him to be finished after the second 'e', in such a manner that the ear will neither expect or wish any thing to follow. The case will be the same if we accompany this modulation with its natural fundamental bass C G C: but if, instead of this bass, we should give it the following, C G A: in this case the modulation 'e d c' would not appear to be finished, and the ear would still expect and desire something more. This experiment may easily be made.

Broken cadences, what, and why. See *Cadence.*

132. This passage G A, when the dominant G diatonically ascends upon the note A instead of descending by a fifth upon the generator C, as it ought naturally to do, is called a *broken cadence;* because the perfect cadence G C, which the ear expected after the dominant G, is, if we may speak so, broken and suspended by the transition from G to A.

133. Hence it follows, that if the modulation 'c d c' appeared finished when we supposed no bass to it at all, it is because its natural fundamental bass C G C is implied; for the ear desires something to follow this modulation, as soon as it is reduced to the necessity of hearing another bass.

Origin of broken cadence the double employment of dissonances.

134. The broken cadence may be considered as having its origin in the *double employment of dissonances;* since this cadence, like the double employment, only consists in a diatonic procedure of the bass ascending (chap. xii.). In effect, nothing hinders us to descend from the chord G B 'd f' to the chord C E G A by converting the tonic C into a sub-dominant, that is to say, by passing all at once from the mode of C to the mode of G: now to descend from G B 'd f' to C E G A is the same thing as to rise from the chord G B 'd f' to the chord A 'e c g', in changing the chord of the sub-dominant C E G A for the imperfect chord of the dominant, according to the laws of the double employment.

Manner of performing this cadence.

135. In this kind of cadence, the dissonance of the first chord is resolved by descending diatonically upon the fifth of the subsequent chord. For instance, in the broken cadence G B 'd f', A 'c e g', the dissonance 'f' is resolved by descending diatonically upon the fifth 'e'.

Interrupted cadence, what. See *Cadence.*

136. There is another kind of cadence, called an *interrupted cadence*, where the dominant descends by a third to another dominant, instead of descending by a fifth upon the tonic, as in this succession of the bass G B 'd f',

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G B 'd f', E G B 'd'; in the case of an interrupted cadence, the dissonance of the former chord is resolved by descending diatonically upon the octave of the fundamental note of the subsequent chord, as may be here seen, where 'f' is resolved upon the octave of E.

Origin of this kind of cadence, likewise in the double employment.

137. This kind of interrupted cadence has likewise its origin in the double employment of dissonances. For let us suppose these two chords in succession, G B 'd f', G B 'd e' where G is successively a tonic dominant and sub-dominant: that is to say, in which we pass from the mode of C to the mode of D; if we should change the second of these chords into the chord of the dominant, according to the laws of the double employment, we shall have the interrupted cadence G B 'd f', E G B 'd.'

Chap. XVIII. *Of the Chromatic Species.*

Fundamental bass formed by thirds major.

138. The series or fundamental bass by fifths produces the diatonic species in common use (chap. vi.); now the third major being one of the harmonics of a fundamental sound as well as the fifth, it follows, that we may form fundamental basses by thirds major, as we have already formed fundamental basses by fifths.

A chromatic interval or minor semitone, how found. See fig. 10.

139. If then we should form this base C, E, G♯, the two first sounds carrying each along with it their thirds major and fifths, it is evident that C will give G, and that E will give G♯: now the semitone which is between this G and this G♯ is an interval much less than the semitone which is found in the diatonic scale between E and F, or between B and 'c'. This may be ascertained by calculation (TT): and for this reason the semitone from E to F is called *major*, and the other *minor* (UU).

140. If the fundamental bass should proceed by thirds minor in this manner, C, E♭, a succession which is allowed when we have investigated the origin of the minor mode (chap. ix.), we shall find this modulation G, G♭, which would likewise give a minor semitone (XX.)

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An intonation minor semitone difficult to be hit, and why.

141. The minor semitone is hit by young practitioners in intonation with more difficulty than the semitone major. For which this reason may be assigned: The semitone major which is found in the diatonic scale, as from E to F, results from a fundamental bass by fifths C F, that is to say, by a succession which is most natural, and for this reason the easiest to the ear. On the contrary, the minor semitone arises from a succession by thirds, which is still less natural than the former. Hence, that scholars may truly hit the minor semitone, the following artifice is employed. Let us suppose, for instance, that they intend to rise from G to G♯; they rise at first from G to A, then descend from A to G♯ by the interval of a semitone major: for this G sharp, which is a semitone major below A, proves a semitone minor above G. [See the notes (TT) and (UU).]

Minor semitone to be found in every procedure of the fundamental bass by thirds.

142. Every procedure of the fundamental bass by thirds, whether major or minor, rising or descending, gives the minor semitone. This we have already seen from the succession of thirds in ascending. The series of thirds minor in descending, C A, gives, C, C♯ (YY); and the series of thirds major in descending, C, A♭, gives C, C♭, (ZZ).

The minor semitone, when prevalent, constitutes chromatic music.

143. The minor semitone constitutes the species, called *chromatic*; and with the species which moves by diatonic intervals, resulting from the succession of fifths (chap. v. and vi.), it comprehends the whole of melody.

Chap. XIX. *Of the Enharmonic Species.*

Diësis or enharmonic interval, what, and how formed.

144. The two extremes, or highest and lowest notes, C G♯, of the fundamental bass by thirds major CEG♯, give this modulation 'c' B♯; and these two sounds 'c' B♯, differ between themselves by a small interval which is called the *diësis*, or *enharmonic fourth* of a tone* (3A). which

* See *Fourth of a Tone.*

(TT) In reality, C being supposed 1, as we have always supposed it, E is $\frac{4}{3}$ and ♯$\frac{25}{16}$: now G being $\frac{1}{2}$, G♯ then shall be to G as $\frac{25}{16}$ to $\frac{1}{2}$; that is to say, as 25 times 2 to 3 times 16: the proportion then of G♯ to G is as 25 to 24, an interval much less than that of 16 to 15, which constitutes the semitone from 'c' to B, or from F to E (note Z).

(UU) A minor joined to a major semitone will form a minor tone; that is to say, if one rises, for instance, from E to F, by the interval of a semitone major, and afterwards from F to F♯ by the interval of a minor semitone, the interval from E to F♯ will be a minor tone. For let us suppose E to be 1, F will be $\frac{16}{15}$, and F♯ will be $\frac{25}{24}$ of $\frac{16}{15}$; that is to say, 25 times 16 divided by 24 times 15, or $\frac{10}{9}$; E then is to F♯ as one is to $\frac{10}{9}$, the interval which constitutes the minor tone (note BB).

With respect to the tone major, it cannot be exactly formed by two semitones; for, 1. Two major semitones in immediate succession would produce more than a tone major. In effect, $\frac{16}{15}$, multiplied by $\frac{16}{15}$ gives $\frac{256}{225}$, which is greater than $\frac{1}{8}$, the interval which constitutes (note BB) the major tone. 2. A semitone minor and a semitone major would give less than a major tone, since they amount only to a true minor. 3. And, *à fortiori*, two minor semitones would still give less.

(XX) In effect, E♭ being $\frac{6}{5}$, G♭ will be $\frac{6}{5}$ of $\frac{6}{5}$; that is to say, (note Q) $\frac{36}{25}$: now the proportion of $\frac{3}{2}$ to $\frac{36}{25}$ (note Q) is that of 3 times 25 to 2 times 36; that is to say, as 25 to 24.

(YY) A being $\frac{5}{6}$ C♯ is $\frac{5}{4}$ of $\frac{5}{6}$; that is to say, $\frac{25}{24}$, and C is 1: the proportion then between C and C♯ is that of 1 to $\frac{25}{24}$, or of 24 to 25.

(ZZ) A♭ being the third major below C, will be $\frac{4}{5}$ (note Q): C♭, then, is $\frac{7}{5}$ of $\frac{4}{5}$; that is to say $\frac{24}{25}$. The proportion, then, between C and C♭, is as 25 to 24.

(3A) G♯ being $\frac{25}{16}$ and B♯ being $\frac{5}{4}$ of $\frac{25}{16}$, we shall have B♯ equal (note Q) to $\frac{125}{64}$, and its octave below shall be $\frac{125}{128}$; an interval less than unity by about $\frac{3}{128}$ or $\frac{1}{43}$. It is plain then, from this fraction, that the B♯ in question must be considerably lower than C.

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which is the difference between a semitone major and a semitone minor (3 B). This quarter tone is inappretiable by the ear, and impracticable upon several of our instruments. Yet have means been found to put it in practice in the following manner, or rather to perform what will have the same effect upon the ear.

Manner of seemingly introducing this interval upon instruments of fixed scales.

145. We have explained (art. 116.) in what manner the chord G♯-B 'd f' may be introduced into the minor mode, entirely consisting of thirds minor perfectly true, or at least supposed such. This chord supplying the place of the chord of the dominant (art. 116.) from thence we may pass to that of the tonic or generator A (art. 117.). But we must remark,

1. That this chord G♯ B 'd f', entirely consisting of thirds minor, may be inverted or medified according to the three following arrangements, B 'd f g♯', D F G♯ B, F G♯ B 'd'; and that in all these three different states, it will still remain composed of thirds minor; or at least there will only be wanting the enharmonic fourth of a tone to render the third minor between F and G♯ entirely just; for a true third minor, as that from E to G in the diatonic scale, is composed of a semitone and a tone both major. Now from F to G there is a tone major, and from G to G♯ there is only a minor semitone. There is then wanting (art. 144.) the enharmonic fourth of a tone, to render the third F G♯ exactly true.

2. But as this division of a tone cannot be found in the gradations of any scale practicable upon most of our instruments, nor be appretiated by the ear, the ear takes the different chords. Theory of Harmony.

B 'd' 'f' 'g♯'
D F G♯ B
F G♯ B 'd',

which are absolutely the same, for chords composed every one of thirds minor are exactly just.

Now the chord G♯ B 'd f', belonging to the minor mode of A, where G♯ is the sensible note; the chord B 'd f g♯', or B 'd f a♭', will, for the same reason, belong to the minor mode of C, where B is the sensible note. In like manner, the chord D F G♯ B, or D F A♭ 'c♭', will belong to the minor mode of E♭, and the chord F G♯ B 'd', or F A♭ 'c♭ e♭♭', to the minor mode of G♭.

After having passed then by the mode of A to the chord G♯ B 'd f' (art. 117.), one may by means of this last chord, and by merely satisfying ourselves to invert it, afterwards pass all at once to the modes of C minor, of E♭ minor, or of G♭ minor; that is to say, into the modes which have nothing, or almost nothing, in common with the minor mode of A, and which are entirely foreign to it (3 c).

146. It must, however, be acknowledged, that a transition so abrupt, and so little expected, cannot deceive nor elude the ear; it is struck with a sensation so unlooked-for, without being able to account for the passage to itself. And this account has its foundation in the enharmonic fourth of a tone; which is overlook- The alteration, however, by which it is effectuated, abrupt and sensible.

This interval has been called *the fourth of a tone*, and this denomination is founded on reason. In effect, we may distinguish in music four kinds of quarter tones.

1. The fourth of a tone major: now, a tone major being $\frac{9}{8}$, and its difference from unity being $\frac{1}{8}$, the difference of this quarter tone from unity will be almost the fourth of $\frac{1}{8}$; that is to say, $\frac{1}{32}$.

2. The fourth of a tone minor; and as a tone minor, which is $\frac{10}{9}$, differs from unity by $\frac{1}{9}$, the fourth of a minor tone will differ from unity about $\frac{1}{36}$.

3. One half of a semitone major; and as this semitone differs from unity by $\frac{1}{17}$, one half of it will differ from unity about $\frac{1}{170}$.

4. Finally, one half of a semitone minor, which differs from unity by $\frac{1}{24}$: its half then will be $\frac{1}{48}$.

The interval, then, which forms the enharmonic fourth of a tone, as it does not differ from unity but by $\frac{1}{32}$, may justly be called the *fourth of a tone*, since it is less different from unity than the largest interval of a quarter tone, and more than the least.

We shall add, that since the enharmonic fourth of a tone is the difference between a semitone major, and a semitone minor; and since the tone minor is formed (note UU) of two semitones, one major and the other minor; it follows, that two semitones major in succession form an interval larger than that of a tone by the enharmonic fourth of a tone; and that two minor semitones in succession form an interval less than a tone by the same fourth of a tone.

(3 B) That is to say, that if you rise from E to F, for instance, by the interval of a semitone major, and afterwards, returning to E, you should rise by the interval of a semitone minor to another sound which is not in the scale, and which I shall mark thus, F+, the two sounds F+ and F will form the enharmonic fourth of a tone: for E being 1, F will be $\frac{16}{15}$; and F+ $\frac{25}{24}$: the proportion then between F+ and F is that of $\frac{25}{24}$ to $\frac{16}{15}$ (note Q); that is to say, as 25 times 15 to 16 times 24; or otherwise, as 25 times 5 to 16 times 8, or as 125 to 128. Now this proportion is the same which is found, in the beginning of the preceding note, to express the enharmonic fourth of a tone.

(3 C) As this method for obtaining or supplying enharmonic gradations cannot be practised on every occasion when the composer or practitioner would wish to find them, especially upon instruments where the scale is fixed and invariable, except by a total alteration of their economy, and re-tuning the strings, Dr Smith in his Harmonies has proposed an expedient for redressing or qualifying this defect, by the addition of a greater number of keys or strings, which may divide the tone or semitone into as many appretiable or sensible intervals as may be necessary. For this, as well as for the other advantageous improvements which he proposes in the structure of instruments, we cannot with too much warmth recommend the perusal of his learned and ingenious book to such of our readers as aspire to the character of genuine adepts in the theory of music.

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ed as nothing, because it is inappretiable by the ear; but of which, though its value is not ascertained, the whole harshness is sensibly perceived. The instant of surprise, however, immediately vanishes; and that astonishment is turned into admiration, when one feels himself transported as it were all at once, and almost imperceptibly, from one mode to another, which is by no means relative to it, and to which he never could have immediately passed by the ordinary series of fundamental notes.

Chap. XX. *Of the Diatonic Enharmonic Species.*

147. If we form a fundamental bass, which rises alternately by fifths and thirds, as F, C, E, B, this bass will give the following modulation 'f, e, e, d♯'; in which the semitones from 'f' to 'e', and from 'e' to 'd♯', are equal and major (3 D).

See fig. 12.

This species of modulation or of harmony, in which all the semitones are major, is called the *enharmonic diatonic* species. The major semitones peculiar to this species give it the name of *diatonic*, because major semitones belong to the diatonic species; and the tones which are greater than major by the excess of a fourth, resulting from a succession of major semitones, give it the name of *enharmonic* (note 3 A).

See *Enharmonic.*

Chap. XXI. *Of the Chromatic Enharmonic Species.*

Chromatic enharmonic intervals, how formed.

148. If we pass alternately from a third minor in descending to a third major in rising, as C, C, A, C♯, C♯, we shall form this modulation 'e♭, e, e, e e♯', in which all the semitones are minor (3 E).

See fig. 13.

This species is called the *chromatic enharmonic* species: the minor semitones peculiar to this kind give it the name of *chromatic*, because minor semitones belong to the chromatic species; and the semitones which are lesser by the diminution of a fourth resulting from a succession of minor semitones, give it the name of *enharmonic* (note 3 F).

From this species, the effects of harmony and melody appear to be in the fundamental bass.

149. These new species confirm what we have all along said, that the whole effects of harmony and melody reside in the fundamental bass.

Diatonic species most agreeable, and why.

150. The diatonic species is the most agreeable, because the fundamental bass which produces it is formed from a succession of fifths alone, which is the most natural of all others.

The chromatic next.

151. The chromatic being formed from a succession of thirds, is the most natural after the preceding.

Lastly, the enharmonic.

152. Finally, the enharmonic is the least agreeable of all, because the fundamental bass which gives it is not immediately indicated by nature. The fourth of a tone which constitutes this species, and which is itself inappretiable to the ear, neither produces nor can produce its effect, but in proportion as imagination suggests the fundamental bass from whence it results; a bass whose procedure is not agreeable to nature, since it is formed of two sounds which are not contiguous one to the other in the series of thirds (art. 144.).

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Chap. XXII. *Showing that Melody is the Offspring of Harmony.*

The effects of melody to be investigated in harmony expressed or understood.

153. All that we have hitherto said, as it seems to me, is more than sufficient to convince us, that melody has its original principle in harmony; and that it is in harmony, expressed or understood, that we ought to look for the effects of melody.

154. If this should still appear doubtful, nothing more is necessary than to pay due attention to the first experiment (art. 19.), where it may be seen that the principal sound is always the lowest, and that the sharper sounds which it generates are with relation to it what the treble of an air is to its bass.

155. Yet more, we have proved, in treating of the broken cadence (chap. xvii.), that the diversification of basses produces effects totally different in a modulation which, in other respects, remains the same.

156. Can it be still necessary to adduce more convincing proofs? We have but to examine the different basses which may be given to this very simple modulation GC. It will be found susceptible of many, and each will give a different character to the modulation GC, though in itself it remains always the same. We may thus change the whole nature and effects of a modulation, without any other alteration than that of its fundamental bass.

M. Rameau has shown, in his *New System of Music*, printed at Paris 1726, p. 44. that this modulation G, C, is susceptible of 20 different fundamental basses. Now the same fundamental bass, as may be seen in our second part, will afford several continued or thorough basses. How many means, of consequence, may be practised to vary the expression of the same modulation?

Consequences deducible from this principle.

157. From these different observations it may be concluded, 1. That an agreeable melody, naturally implies a bass extremely sweet and adapted for singing; and that reciprocally, as musicians express it, a bass of this kind generally prognosticates an agreeable melody (3 F).

2. That the character of a just harmony is only to form in some measure one system with the modulation, so

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(3 D) It is obvious, that if F in the bass be supposed 1, 'f' of the scale will be 2, C of the bass $\frac{3}{2}$ and 'e' of the scale $\frac{5}{4}$ of $\frac{3}{2}$, that is $\frac{15}{8}$; the proportion of 'f' to 'e' is as 2 to $\frac{15}{8}$, or as 1 to $\frac{15}{16}$. Now E of the bass being likewise $\frac{5}{4}$ of $\frac{3}{2}$, or $\frac{15}{8}$; B of the bass is $\frac{3}{2}$ of $\frac{15}{8}$, and its third major D♯ $\frac{5}{4}$ of $\frac{3}{2}$ of $\frac{15}{8}$, or $\frac{15}{8}$ of $\frac{15}{8}$; this third major, approximated as much as possible to 'e' in the scale by means of octaves, will be $\frac{15}{16}$ of $\frac{15}{8}$: 'e' then of the scale will be to 'd'♯ which follows it, as $\frac{15}{8}$ is to $\frac{15}{16}$ of $\frac{15}{8}$, that is to say, as 1 to $\frac{15}{16}$. The semitones then from 'f' to 'e', and from 'e' to 'd'♯, are both major.

(3 E) It is evident that 'e'♭ is $\frac{6}{7}$ (note Q), and that 'e' is $\frac{5}{4}$: these two 'e's, then, are between themselves as $\frac{6}{7}$ to $\frac{5}{4}$, that is to say, as 6 times 4 to 5 times 5, or as 24 to 25, the interval which constitutes the minor semitone. Moreover, the A of the bass is $\frac{5}{6}$, and C ♯ $\frac{5}{4}$ of $\frac{5}{6}$, or $\frac{25}{24}$: 'e'♯ then is $\frac{5}{4}$ of $\frac{25}{24}$, the 'e' in the scale is likewise to the 'e'♯ which follows it, as 24 to 25. All the semitones therefore in this scale are minor.

(3 F) Many composers begin with determining and writing the bass; a method, however, which appears in general

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so that from the whole taken together, the ear may only receive, if we may speak so, one simple and indivisible impression.

3. That the character of the same modulation may be diversified, according to the character of the bass which is joined with it.

But notwithstanding the dependency of melody upon harmony, and the sensible influence which the latter may exert upon the former; we must not however conclude, with some celebrated musicians, that the effects of harmony are preferable to those of melody. Experience proves the contrary. [See, on this account, what is written on the license of music, printed in tom. iv. of D'Alembert's *Melanges de Literature*, p. 448.].

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The diatonic scale or gammut being composed of twelve semitones, it is clear that each of these semitones taken by itself may be the generator of a mode; and that thus there must be twenty-four modes in all, twelve major and twelve minor. We have assumed the major mode of C, to represent all the major modes in general, and the minor mode of A to represent the modes minor, to avoid the difficulties arising from sharps and flats, of which we must have encountered either a greater or lesser number in the other modes. But the rules we have given for each mode are general, whatever note of the gammut be taken for the generator of a mode.

PART II. PRINCIPLES AND RULES OF COMPOSITION.

Composition in harmony, what. See *Composition.*

158. COMPOSITION, called also *counterpoint*, is not only the art of composing an agreeable air, but also that of composing several airs in such a manner that when heard at the same time, they may unite in producing an effect agreeable and delightful to the ear; this is what we call *composing music in several parts.*

The highest of these parts is called the *treble*, the lowest is termed the *bass;* the other parts, when there are any, are termed *middle parts;* and each in particular is signified by a different name.

CHAP. I. *Of the Different Names given to the same Interval.*

Particular intervals signified by different names, and why.

159. IN the introduction (art. 9.), we have seen a detail of the most common names given to the different intervals. But particular intervals have obtained different names, according to circumstances; which it is proper to explain.

Second redundant, what.

160. An interval composed of a tone and a semitone, which is commonly called a *third minor*, is likewise sometimes called a *second redundant;* such is the interval from C to D𝄪 in ascending, or that of A to G♭ descending.

Why so called.

This interval is so termed, because one of the sounds which form it is always either sharp or flat, and that, if that sharp or flat be taken away, the interval will be that of a second (3 G).

False fifth, what.

161. An interval composed of two tones and two semitones, as that from B to 'f', is called a *false fifth.* This interval is the same with the *tritone* (art. 9.), since two tones and two semitones are equivalent to three tones. There are, however, reasons for distinguishing them, as will appear below.

Fifth redundant, what.

162. As the interval from C to D𝄪 in ascending has been called a second redundant, we likewise call the interval from C to G𝄪 in ascending, a *fifth redundant*, or from B to E♭ in descending, each of which intervals is composed of four tones (3 H).

Distinguished from the sixth minor.

This interval is, in the main, the same with that of the sixth minor (art. 6.): but in the fifth redundant there is always a sharp or flat; insomuch, that if this sharp or flat were removed, the interval would become a true fifth.

Seventh diminished, what.

163. For the same reason, an interval composed of three tones and three semitones, as from G𝄪 to 'f' in ascending, is called a *seventh diminished;* because, if we remove the sharp from G, the interval from G to 'f' will become that of an ordinary seventh. The interval of a seventh diminished is in other respects the same with that of the sixth major (art. 9.) (3 I).

Seventh major and redundant coincident.

164. The major seventh is likewise sometimes called a *seventh redundant* (3 K).

CHAP. II. *Comparison of the Different Intervals.*

Notes in different octaves or scales replications each of the other.

165. IF we sing 'c' B in descending by a second, and afterwards C B in ascending by a seventh, these two B's shall be octaves one to the other; or, as we commonly express it, they will be *replications* one of the other.

166. On account then of the resemblance between every

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general more proper to produce a learned and harmonious music, than a strain prompted by genius and animated by enthusiasm.

(3 G) For the same reason, this interval is frequently termed by English musicians an *extreme sharp second.*

(3 H) This interval is usually termed by English theorists *a sharp fifth.*

(3 I) The material difference between the diminished seventh and the major sixth is, that the former always implies a division of the interval into three minor thirds, whereas a division into a fourth and third major, or into a second and major and minor third, is usually supposed in the latter.

(3 K) The chief use of these different denominations is therefore to distinguish chords: for instance, the chord of the redundant fifth and that of the diminished seventh are different from the chord of the sixth; the chord of the seventh redundant, from that of the seventh major. This will be explained in the following chapters.

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every sound and its octave (art. 22.), it follows, that *to rise by a seventh*, or *descend by a second*, amount to the same thing.

Hence to descend to one replication, and rise to another, has the same effect.

167. In like manner, it is evident that the sixth descending is nothing but a replication of the third ascending, nor the fourth descending but a replication of the fifth ascending.

168. The following expressions either are or ought to be regarded as synonymous.

Detail of replications. Examples of this.

To rise by a second.—To descend by a seventh.
To descend by a second.—To rise by a seventh.
To rise by a third.—To descend by a sixth.
To descend by a third.—To rise by a sixth.
To rise by a fourth.—To descend by a fifth.
To descend by a fourth.—To rise by a fifth.

169. Thus, therefore, we shall employ them indifferently the one for the other; so that when we say, for instance, *to rise by a third*, it may be said with equal propriety *to descend by a sixth*, &c. Principles of Composition.

Chap. III. *Of the Cleffs; of the Value or Quantity; of the Rhythm; and of Syncopation.*

170. There are three cleffs † in music; the F cleff 𝄢; the C cliff 𝄡; and the G cleff 𝄞.

† See *Cleffs*, what,

The F cleff is placed on the fourth line (3 L) or on the third; and the line on which this cleff is placed gives the name of F to all the notes on that line. and how placed.

The C cleff is placed on the fourth, the third, the second, or the first line: and in these different positions all Plate CCCLV. Fig. 1. Fig. 2.

(3 L) Our author has treated this part of his subject with somewhat less perspicuity than usual. He has neither described the staffs or systems of lines on which the cleffs are placed, nor explained their relation to each other. We have therefore attempted to supply the deficiency.

Musical sounds, like language, are represented by written characters, by which their graveness or acuteness, their duration, and the other qualities intended to be assigned to them, are accurately distinguished.

The characters which denote the graveness or acuteness, or, as it is termed, the *pitch* of sounds, are intended to represent the ordinary limits of the human voice, in the exercise of which, or the employment of instruments of nearly the same compass with it, all practical music consists.

From the lowest distinct note, without straining, of the masculine voice, to the highest note generally produced by the female voice, there is an interval of three octaves, or twenty-two diatonic notes.

These notes are represented by characters described alternately on eleven parallel lines, and the spaces between them, forming what we shall here term the *general system*.

The characters representing the notes are differently formed according to their duration, but with this we have at present no concern. We shall employ the simplest, a small circle or ellipse.

The whole extent of the human voice, then, if described upon the *general system*, would be represented as at Plate CCCLV. fig. 1.

The masculine voice, rising from the lowest note of the general system, will, generally speaking, reach the note on the central line; and an ordinary female voice will reach the same note, descending from the highest. Male voices more acute, and female voices graver than usual, will consequently execute this note with greater facility.

This central note, then, being producible by every species of voice, has been assumed as a fundamental or key note, by which all the others are regulated (art. 4.). And to it is assigned the name of C, by which, in the theory of harmony, (as we have seen), the fundamental sound of the diatonic scale is distinguished.

The other notes take their denominations accordingly. The note below it is B, that above it 'd', &c.; and to distinguish this central C from its octaves, it is called the *middle* or *tenor* C.

As no human voice can execute the whole twenty-two notes, the general system is divided into portions of five lines, each portion representing the compass of an ordinary voice; and different portions are made use of, according to the graveness or acuteness of different voices.

The five lines in this state form what is called a *staff*. Each staff is subdivided into *lines* and *spaces*. On the lines, and in the spaces, the heads of the notes are placed. The lines and spaces are counted upwards, from the lowest to the highest; the lowest line is termed the *first line;* the space between it and the *second line* is denominated the *first space*, and so on. Both lines and spaces have the common name of *degrees;* the staff thus contains nine degrees, viz. five lines and four spaces.

To ascertain what part of the general system is formed by a *staff*, one of the *cleffs* mentioned in the text is placed at the beginning of the staff, on one or other of the lines of it.

The C or tenor cleff always denotes the line on which it is placed to be that which carries the tenor C. The G or treble cleff distinguishes the line carrying 'g', the perfect fifth *above* the tenor C. And the F or bass cleff ascertains the line which represents F the perfect fifth *below* the tenor C.

The figures of the cleffs, (which are characters gradually corrupted from the Gothic C, G, and F), and their places in the general system, appear on Plate CCCLV. fig. 2.

By this disposition of the cleffs, we see that the staff, which includes the line bearing the treble cleff, is formed by the five highest lines of the general system; and that the staff which comprehends the bass cleff consists of the five lowest.

The central line, which carries the tenor C, belongs neither to the treble nor the bass staves. But as that note frequently occurs in composition written on these staves, a small portion of the tenor line is occasionally introduced below the treble cleff and above that of the bass (fig. 3.).

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all the notes on the same line with the cleff take the name of C.

The G cleff is placed on the second or first line; and all the notes on the line of the cleff take the name of G.

Fig. 7. 3.

Names of the notes to be investigated from the position of the cleffs.

171. As the notes are placed on the lines, and in the spaces between the lines, the name of any note may be discovered from the position of the cleff. Thus, in the F cleff, the note on the lowest line is G; the note on the space between the two first lines A; the note on second line B, &c.

Marks and power of sharps, flats, and naturals.

172. A note before which there is a sharp (marked thus ♯) must be raised by a semitone; and if there be a flat (marked ♭) before it, it must be depressed by a semitone.

The natural (marked thus ♮) restores to its natural value a note which had been raised or depressed by a semitone.

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Fig. 8.

173. When a sharp or a flat is placed at the cleff, all the notes upon the line or space on which this sharp or flat is marked, are sharp or flat. For instance, if in the cleff of G a sharp be placed on the highest line, which is the place of '*f*', all the notes on that line will be '*f*♯'—to restore them to the original value of '*f*' natural, a ♮ must be placed before them.

Fig. 9.

In the same manner, if a flat be marked at the cleff, all the notes on the same line or space with the flat will be flat; to restore them to their natural state, a ♮ must be placed before them (3 M).

Bars and Times, what,

174. Every piece of music is divided into different equal

As notes still more remote from the staff in use are sometimes introduced, small portions of the lines to which these lines belong are employed in the same manner. Thus, if in writing in the bass staff we want the note properly placed on the lowest line of the treble staff, we draw two short lines above the bass staff, one representing the tenor line, and the other the lowest line of the treble staff, and on this last short line we place the note in question, (fig. 4.).

On the other hand, if, in writing on the treble staff, we would employ a note properly belonging to the bass staff, we place it below the treble staff, and insert the requisite short lines, representing the corresponding lines of the general system (fig. 5.).

The occasional short lines thus employed are termed *leger lines*.

The same expedient is used to represent notes beyond the limits of the general system. Thus, we write the F which is one degree lower than the lowest G of the bass staff, on the space below that G; the E immediately lower, or on a leger line below the bass staff, and so on. Notes in this position are termed *double;* thus, the F just mentioned is double F, or FF; the E, or double E, EE, &c.

Again, the '*a*' above the highest '*g*' of the treble staff is placed on a leger line above that staff. The '*b*' is placed on the space above the leger line: The next note '*c*' is set on a second leger line, and so on. These high notes are, in compositions for some instruments, carried more than an octave above the general system. Those in the first octave are said to be *in alt;* those beyond it, to be *in altissimo*.

The tenor or C cleff is employed to form different intermediate staves between the treble and bass, according to the compass of the voice or instrument for which the staff is wanted.

Compositions for the gravest masculine voices and instruments are written on the bass cleff, and those for female voices and instruments highest in tone, on the treble staff*.

For masculine voices next in depth to the bass, and for the higher octave of the violoncello and bassoon, a staff, called the *tenor staff*, is formed by adding to the tenor line the three highest lines of the bass staff and the lowest line of the treble (fig. 6. 1.).

For the highest masculine voices, which are called *counter tenor*, and for the tenor violin, a staff is formed by the tenor line, the two highest lines of the bass, and the two lowest of the treble staff (fig. 6. 2.).

For the gravest female voices, which are called *mezzo soprano*, the tenor line and four lowest lines of the treble form a staff (fig. 6. 3.)

The relation of all the staves to the general system, and to each other, will appear from fig. 6.

The bass cleff on the third line, the tenor cleff on the second, and the treble cleff on the first, rarely occur, except in old French music.

The tenor cleff, and the staves distinguished by it, are now less frequently used than the treble and bass cleffs. Those who cultivate music only as an amusement find it irksome to learn so many modes of notation. The tenor staves are accordingly banished from compositions for keyed instruments. Secular compositions for voices are likewise now written in the treble and bass staves only; although in this there is some inaccuracy, as the tenor parts now written in the treble staff, must often be sung an octave below that in which they appear. The chief use of the tenor cleff is in choral music and compositions for the bassoon and tenor violin; and its principal advantage, the facility of reading ancient music, which is almost exclusively written in this cleff, has seldom been deemed an insufficient recompense for the labour of acquiring it.

(3 M) The disposition of sharps or flats at the cleff, which is termed the *signature*, depends upon the mode, or tone assumed in the composition as a fundamental or key note, and will be afterwards explained.

The sharps or flats of the signature affect not only the notes placed on the same *degree* with themselves, as mentioned in the text, but also all the notes of the same letter, in every octave throughout the movement.

The sharps or flats of the signature determine the scale in which the movement is composed, and are therefore said to be *essential;* those which occur in the course of the piece on an occasional change of the scale, are termed *accidental*.

* Compositions for *French horns* are written in the treble staff, although the tone of the instrument be very grave; but this is because the horn is borrowed from, and has the same natural intervals with the *Trumpet*, which is an acute instrument.

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equal times, called *measures*; and each measure is likewise divided into different times.

See *Time*.

There are properly two kinds of measures or modes of time; the measure of two times, or common time, marked by the figure 2 at the beginning of the time (fig. 10.); and the measure of three times, or triple time, marked by the figure 3 placed in the same manner (fig. 11.).

The different measures are distinguished by perpendicular lines (3 N), called *bars*.

In a measure, we distinguish between the *strong* and the *weak* time: the *strong* time is that which is *beat;* the *weak*, that in which the hand or foot *is raised*. A measure consisting of four times ought to be considered as compounded of two measures, each consisting of two times: thus there are in this measure two *strong* and two *weak* times. In general by the words *strong* and *weak* even the parts of the same time are distinguished; thus, the first note of each time is considered as *strong* and the others as *weak*.

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175. The longest of all notes is a *semibreve*. A *minim* is half its value; that is to say, two minims are to be performed in the time occupied by one semibreve. A miuim in the same manner is equivalent to two *crotchets*, the crotchet to two *quavers* (3 O).

The value of notes in duration. Fig. 12.

176. A note which is divided into two parts by a *bar*, that is, which begins at the end of a measure, and terminates in the measure following, is called a *syncopated* note (3 P).

Syncopation, what. See *Syncopation*.

177. A note followed by a point or dot is increased half its value. Thus a *dotted* semibreve is equivalent to a semibreve and a minim, a dotted minim, to a minim and a crotchet, &c. (Fig. 17.) (3 Q).

Value of a pointed note.

CHAP.

(3 N) All the notes, therefore, contained between two bars constitute one measure; although in common language the word bar is improperly used for measure.

(3 O) The notes, in their figure, consist of a *head* and a *stem*, except the semibreve, which has a *head* only.

The place of the note in the staff is determined by the *head*, which must be placed *on* the line, or *in* the space, assigned to the note. The *stem* may be turned either up or down.

The quaver is equivalent to two *semiquavers*, and the semiquaver to two *demi-semiquavers*. In modern music the demi-semiquaver is also subdivided.

The quaver and the notes of shorter duration may be grouped together, by two, three, or four, &c. and joined by as many black lines across the ends of the stem as there are hooks in the single note (fig. 12). This arrangement is convenient in writing, and assists the eye in performance.

When quavers, or the shorter notes, are to be repeated in the same degree for a time equal to the duration of a longer note, the iterations are, by a sort of musical short-hand, represented by writing the long note only, and placing over or under it, as many short lines as the short note has hooks (fig. 13.) And the repetition of a series of short notes is represented by merely writing for each repetition as many short lines as there are hooks to the short notes of which the series is composed (fig. 14.).

(3 P) A note in the middle of a measure is also said to be syncopated when it begins on a *strong*, and ends on a *weak* part of the measure, (see fig. 15.) where D, C, and B are each of them syncopated.

A note which of itself occupies one, two, or more measures, is not said to be syncopated, but *continued* or *protracted*. See fig. 16.

(3 Q) Notes have sometimes in modern music a double dot after them, which makes them longer by three-fourths. Thus a minim twice dotted is equal to three crotchets and a half, or seven quavers, &c.

Our author, in this chapter, has omitted the explanation of *rests*, and of the particular modifications of time.

Rests are characters indicating the temporary suspension of musical sounds. There are as many different rests as there are notes. Thus the semibreve rest indicates a pause of the duration of a semibreve; the minim rest, of a minim, &c. (fig. 18.).

The semibreve rest also denotes the silence of one entire measure, in triple as well as common time. The silence of several measures is marked as in fig. 18.; but where the silence exceeds three bars, the number is usually marked over the rests.

Common time is either of a semibreve, or of a minim to the measure.

Common time of a semibreve is indicated by the letter C at the cleff, fig. 1. of Plate CCCLVI. When it is meant to be somewhat quicker than usual, a perpendicular line is drawn through the C, (fig. 2.).

Common time of a minim to the measure, which is called *half time*, is indicated by the fraction $\frac{2}{4}$, that is, two-fourths of a semibreve, or two crotchets equal to a minim, (fig. 3.).

In triple time the measure consists of three minims, three crotchets or three quavers, six crotchets or six quavers, nine quavers or twelve quavers.

Triple time of three minims is marked at the cleff $\frac{3}{2}$, that is, three halves of a semibreve, (fig. 4.)

Triple time of three crotchets is indicated by the fraction $\frac{3}{4}$, (three-fourths of a semibreve) (fig. 5.) and that of three quavers by $\frac{3}{8}$ (three-eighths of a semibreve), (fig. 6.)

In the last three examples the measure is divided into three *times*, of which the first is *strong*, and the two others weak.

The measure of six crotchets is marked $\frac{6}{4}$, (fig. 7.); and that of six quavers $\frac{6}{8}$, (fig. 8.). In both there are two times, of which the first is strong, and the second weak.

The measure of nine quavers is marked $\frac{9}{8}$, (fig. 9.); and is divided into one strong and two weak times. That of twelve quavers is marked $\frac{12}{8}$. (fig. 10.); and is accented as if it were two measures of six quavers.

The measures of $\frac{9}{4}$ and $\frac{9}{16}$ rarely occur.

Three notes are often performed in the time of two of the same name, and are then termed *triplets*, (fig. 11.) where

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Chap. IV. *Definition of the principal Chords.*

Perfect chords, what.

178. (3 R) The chord composed of a third, a fifth, and an octave, as C, E, G, C, is called a *perfect chord* (art. 32.).

If the third be major, as in C, E, G, C, the perfect chord is denominated *major:* if the third be minor, as in A, C, E, A, the perfect chord is minor. The perfect chord major constitutes the *major mode;* and the perfect chord minor, the *minor mode* (art. 31.).

Chord of the seventh, what, and how to be practised.

179. A chord composed of a third, a fifth, and a seventh, as G, B, D, F, or D, F, A, C, &c. is called a *chord of the seventh.* Such a chord is wholly composed of thirds in ascending.

All chords of the seventh are practised in harmony, save that which might carry the third minor and the seventh major, as C E♭ G B; and that which might carry a false fifth and a seventh major, B D F A♯, (chap. xiv. Part I.).

Those of different kinds.

180. As thirds are either major or minor, and as they may be differently arranged, it is clear that there are different kinds of chords of the seventh; there is even one, B D F A, which is composed of a third, a false fifth, and a seventh.

Of the greater sixth, what.

181. A chord composed of a third, a fifth, and a sixth, as F A C D, D F A B, is called a *chord of the greater sixth.*

182. Every note which carries a perfect chord is called a *tonic;* and a perfect chord is marked by an 8, by a 3, or by a 5, which is written above the note; but frequently these numbers are suppressed. Thus in the example 1. the two C's equally carry a perfect chord.

Plate CCCLVII

Tonic, what, and its chords, how figured.

183. Every note which carries a chord of the seventh is called a *dominant* (art. 102.); and this chord is marked by a 7 written above the note. Thus in the example II. D carries the chord D F A C, and G the chord G B D F.

Dominant, what, and how figured.

It is necessary to remark, that among the chords of the seventh we do not reckon the chord of the seventh diminished, which is only improperly called a *chord of the seventh;* and of which we shall say more below.

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184. Every note which carries the chord of the great sixth, is called a *subdominant*, (art. 97. and 42.) and is marked with a 6. Thus in the example III. F carries the chord of F A C D. The sixth should always be major, (art. 97. and 109.).

Sub-dominant what, and how figured.

185. In every chord, whether perfect, or a chord of the seventh, or of the great sixth, the note which carries this chord, and which is the flattest or lowest, is called the *fundamental note.* Thus C in the example I. D and C in the example II. and F in the example III. are fundamental notes.

Fundamental note, what.

See *Fundamental.*

186. In every chord of the seventh, and of the great sixth, the note which forms the seventh or sixth above the fundamental, that is to say, the highest note of the chord, is called a *dissonance.* Thus in the chords of the seventh G B D F, D F A C, F and C are the dissonances, viz. F with relation to G in the first chord, and C with relation to D in the second. In the chord of the great sixth F A C D, D is the dissonance (art. 120.); but that D is only, properly speaking, a dissonance with relation to C from which it is a *second*, and not with respect to F from which it is a *sixth major* (art. 17. and 18.).

Dissonance of a chord, what.

187. When a chord of the seventh is composed of a third major followed by two thirds minor, the fundamental note of this chord is called the *tonic dominant.* In every other chord of the seventh the fundamental is called the *simple dominant* (art. 102.). Thus in the chord G B D F, the fundamental G is the *tonic dominant;* but in the other chords of the seventh, as C E G B, D F A C, &c. the fundamentals C and D are *simple dominants.*

Tonic and simple dominant, what.

188. In every chord, whether perfect, or of the seventh, or of the sixth, if it is meant that the third above the fundamental note should be major though it be naturally minor, a sharp must be placed above the fundamental

Major chords, how rendered minor, and *vice versa.*

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where the groups of quavers in the second measure are triplets, and each triplet occupies the time of two quavers only. Triplets also occur in triple time, fig. 12.

Certain other characters will be with propriety explained here.

The *Pause* signifies that the regular time is to be delayed, and the note marked with the pause protracted. See fig. 13. where the pause is on the last note of the second measure.

The *Repeat*, a character resembling an S, denotes, that the following part of the movement must be repeated. See fig. 14.

The *Direct* (fig. 15.) is placed at the end of the staff, to shew upon what degree the first note of the following staff is placed.

When the inner sides of two bars are dotted, the measures between them are to be repeated (fig. 16.). The word *bis* is sometimes placed over such passages.

The double bar distinguishes the end of a movement or strain, (fig. 17.). If the double bar be dotted on one or both sides, the strain is to be repeated, (fig. 18.). The double bar does not affect the time; so that when the strain terminates before the end of a measure, as is often the case, the double bar only marks the conclusion of the strain, but the time is kept exactly as if it were not inserted. See fig. 19.

The graces of exertion and expression, such as the appogiature, the shake, the slur, the crescendo, the diminuendo, &c. are not necessary to the consideration of the theory of music or principles of composition, but belong to the performer only. See Shake, &c.

(3 R) In this part of our subject, we shall, in mentioning the harmonies of the chords, make use of the capital letters only, as the general names of the notes, without distinguishing octaves by minuscular or Italic letters. The harmonics may be arranged in different octaves. Their different positions will be most easily seen and best understood from the examples in the plates.

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fundamental note. For example, if we would mark the perfect major chord D F♯ A D, as the third F above D is naturally minor, we place above D a sharp, as in Example IV. In the same manner, the chord of the seventh D F♯ A C, and the chord of the great sixth D F♯ A B, is marked with a ♯ above D, and above the ♯ a 7 or a 6 (see V. and VI.).

On the contrary, when the third is naturally major, and if we would render it minor, we place above the fundamental note a ♭. Thus the example VII. VIII. IX. shew the chords G B♭ D G G B♭ D F, G B♭ D E (3 s).

CHAP. V. *Of the Fundamental Bass.*

Fundamental bass how formed.

189. LET a modulation be invented at pleasure; and under this modulation let there be set a bass composed of different notes, of which some may carry a perfect chord, others that of the seventh, and others that of the great sixth, in such a manner that each note of the modulation which answers to each of the bass, may be one of those which enters into the chord of that note in the bass; this bass being composed according to the rules which shall be immediately given, will be the *fundamental bass* of the modulation proposed. See Part I. where *the nature and principles of the fundamental bass* are explained.

See *Fundamental bass.*

Thus (Exam. XVI.) it will be found that this modulation, C D E F G A B C, has or may admit for its fundamental bass, C $\overset{7}{G}$ C $\overset{6}{F}$ C $\overset{7}{D}$ $\overset{7}{G}$ C.

In reality, the first note C in the upper part is found in the chord of the first note C in the bass, which chord is G E G C; the second note D in the treble is found in the chord G B D G; which is the chord of the second note in the bass, &c. and the bass is composed only of notes which carry a perfect chord, or that of the seventh, or that of the great sixth. Moreover it is formed according to the rules which we are now about to give.

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CHAP. VI. *Rules for the Fundamental Bass.*

Rules for the formation of the bass.

190. ALL the notes of the fundamental bass being only capable of carrying a perfect chord, or the chord of the seventh, or that of the great sixth, are either tonics, or dominants, or sub-dominants; and the dominants may be either simple or tonic.

The fundamental bass ought always to begin with a tonic, as much as it is practicable. And now follow the rules for all the succeeding chords; rules which are evidently derived from the principles established in the *First Part* of this treatise. To be convinced of this we shall find it only necessary to review the articles 34, 91, 122, 124, 126, 127.

RULE I.

191. In every chord of the tonic, or of the tonic dominant, it is necessary that at least one of the notes which form that chord should be found in the chord that precedes it.

RULE II.

192. In every chord of the simple dominant, it is necessary that the note which constitutes the seventh, or dissonance, should likewise be found in the preceding chord.

RULE III.

193. In every chord of the sub-dominant, at least one of its consonances must be found in the preceding chord. Thus, in the chord of the sub-dominant F A C D, it is necessary that F, A, or C, which are the consonances

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(3 s) We may only add, that there is no occasion for marking these sharps or flats when they are originally placed at the cleff. For instance, if the sharp be upon F which indicates the key of G (see Exam. X.) it is sufficient to write D, without a sharp, to mark the perfect chord major of D, D F♯ A D. In the same manner, in the Example XI. where the flat is at the cleff upon B, which denotes the key of F, it is sufficient to write G, to mark the perfect chord minor of G B♭ D G.

But where there is a sharp or a flat at the cleff, if we would render the chord minor which is major, or *vice versa*, we must place above the fundamental note a ♮ or natural. Thus the Example XII. marks the minor chord D F A D, and Example XIII. the major chord G B D G.—Sometimes, in lieu of a natural, a flat is used to signify the minor chord, and a sharp to signify the major. Thus Example XIV. in the key of G, marks the minor chord D F A D, and Example XV. in F, the major chord G B D G.

When in a chord of the great sixth, the dissonance, that is to say, the sixth, ought to be sharp, and when the sharp is not found at the cleff, we write before or after the 6 a ♯; and if this sixth should be flat according to the cleff, we write a ♮.

In the same manner, if in a chord of the seventh of the tonic dominant, the dissonance, that is to say, the seventh, ought to be flat or natural, we write by the side of the seventh a ♭ or a ♮. Many musicians, when a seventh from the simple dominant ought to be altered by a sharp or a natural, have likewise written by the side of the seventh a ♯ or a ♮; but M. Rameau suppresses these characters. The reason shall be given below, when we speak of chords by supposition.

If there be one sharp at the cleff, and if we would mark the chord G B D F♮ or the chord A C E F♮, we ought to place before the seventh or the sixth a ♮ or a ♭.

In the same manner, if there be one flat at the cleff, and if we would mark the chord C E G B♮, we ought to place before the seventh a ♯ or a ♮; and so of the rest.

All these intricate combinations of figuring shew the superior convenience of the modern method of writing the notes themselves instead of the figures, which has the farther advantage of exhibiting the proper arrangement of the chord, see Example II.

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consonances of the chord, should be found in the chord preceding. The dissonance D may either be found in it or not.

Rule IV.

194. Every simple or tonic dominant ought to descend by a fifth. In the first case, that is to say, when the dominant is simple, the note which follows can only be a dominant; in the second it may be any one; or, in other words, it may either be a tonic, a tonic dominant, a simple dominant, or a sub-dominant. It is necessary, however, that the conditions prescribed in the second rule should be observed, if it be a simple dominant.

This last reflection is necessary, as will presently be seen. For, let us assume the succession of the two chords A C♯ E G, D F A C (see Exam. XVII.), this succession is by no means legitimate, though in it the first dominant descends by a fifth; because the C which forms the dissonance in the second chord, and which belongs to a simple dominant, is not in the preceding chord. But the succession will be admissible, if, without meddling with the second chord, we take away the sharp carried by the C in the first; or if, without meddling with the first chord, we render C and F sharp in the second (3 T); or, if we simply render the D of the second chord a tonic dominant, in causing it to carry F♯ instead of F♮ (119. and 122.).

It is likewise by the same rule that we ought to reject the succession of the two following chords,

D F A C, G B D F♯;

(see Exam. XVIII.).

Rule V.

195. Every sub-dominant ought to rise by a fifth; and the note which follows it may, at pleasure, be either a tonic, a tonic dominant, or a sub-dominant.

Remark.

Other rules substituted

Of the five fundamental rules which have now been given, instead of the three first, one may substitute the three following, which are consequences from them.

Rule I.

If a note of the fundamental bass be a tonic, and rise by a fifth or a third to another note, that second note may be either a *tonic* (34. & 91.), see Examples XIX. and XX. (3 U); a *tonic dominant* (124.), see XXI. and XXII.; or a *sub-dominant* (124.), see XXIII. and XXIV; or, to express the rule more simply, that second note may be any one, except a *simple dominant*.

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Rule II.

If a note of the fundamental bass be a tonic, and descend by a fifth or a third upon another note, this second note may be either a tonic (34. & 91.) see Exam. XXV. and XXVI.; or a tonic dominant, or a simple dominant, yet in such a manner that the rule of art. 192. may be observed (124.), see XXVII. XXVIII. XXIX. and XXX.; or a sub-dominant (124.), see XXXI. and XXXII.

The succession of the bass C E♭ G C, F A C E, is excluded by art. 192.

Rule III.

If a note in the fundamental bass be a tonic, and rise by a second to another note, that note ought to be a tonic dominant, or a simple dominant (101. & 102.). See XXXIV. and XXXV. (3 X).

We must here advertise our readers, that the examples XXXVI. XXXVII. XXXVIII. XXXIX. belong to the fourth rule above, art. 194.; and the examples XL. XLI. XLII. to the fifth rule above, art. 195. See the articles 34, 35, 121, 123, 124.

Remark I.

Perfect and imperfect cadences, what, and how employed.

196. The transition from a tonic dominant to a tonic is called an *absolute repose*, or a *perfect cadence* (73.); and the transition from a sub-dominant to a tonic is called an *imperfect* or *irregular cadence* (73.); the tonic falls upon the accented part of the bar. See XLIII. XLIV. XLV. XLVI.

Remark II.

Syncopation only admissible in the fundamental bass by license.

197. We must avoid, as much as we can, syncopations in the fundamental bass; that the ear may accurately distinguish the primarily accented part of a measure, by means of a harmony different from that which it had before perceived in the last unaccented part of the preceding measure. Nevertheless syncopation may be sometimes admitted in the fundamental bass, but it is by a license (3 Y).

(3 T) In this chord it is necessary that the C and F should be sharp at the same time; for the chord D F A C ♯, in which C would be sharp without the F, is excluded by art. 179.

(3 U) When the bass rises or descends from one tonic to another by the interval of a third, the mode is commonly changed; that is to say, from a major it becomes a minor. For instance, if we ascend from the tonic C to the tonic E, the major mode of C, C E G C, will be changed into the minor mode of E, E G B E. We must never ascend from one tonic to another, when there is no sound common to both their modes: for example, we cannot rise from the mode of C, C E G C, to the minor mode of E♭, E♭ G♭ B♭ F♭ (91.).

(3 X) Thus all the intervals, viz. the third, the fifth, and second, may be admitted in the fundamental bass, except that of a second in descending. The rules now given for the fundamental bass, are not, however, without exception, as approved compositions in music will certainly discover; but these exceptions being in reality licences, and for the most part in opposition to the great principle of connection, which prescribes that there should be at least one note in common between a preceding and a subsequent chord, it does not seem necessary to enter into a minute detail of these licences in an elementary work, where the first and most essential rules of the art alone ought to be expected.

(3 Y) There are notes which may be found several times in the fundamental bass in succession with a different

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Chap. VII. *Of the Rules which ought to be observed in the Treble with relation to the Fundamental Bass.*

Definition of treble.

198. The treble is nothing else but a modulation above the fundamental bass, and whose notes are found in the chords of that bass which corresponds with it (189.). Thus in Ex. XVI. the scale C D E F G A B C, is a treble with respect to the fundamental bass C G C F C D G C.

One note in the treble or bass may answer to its correspondent parts, and why.

199. We are about to give the rules for the treble; but first we think it necessary to make the two following remarks.

1. It is obvious, that many notes of the treble may answer to one and the same note in the fundamental bass, when these notes belong to the chord of the same note in the fundamental bass. For example, this modulation C E G E C, may have for its fundamental bass the note C alone, because the chord of that note comprehends the sounds C, E, G, which are found in the treble.

2. In like manner, a single note in the treble may, for the same reason, answer to several notes in the bass. For instance, G alone may answer to these three notes in the bass, C G C (3 z).

Rule I. *For the Treble.*

200. If the note which forms the seventh in a chord of the *simple dominant*, is found in the treble, the note which precedes it must be the very same. This is what we call a *discord prepared* (122). For instance, let us suppose that the note of the fundamental bass shall be D, bearing the chord of the simple dominant D F A C; and that this C, which (art. 18. and 118.) is the dissonance, should be found in the treble; it is necessary that the note which goes before it in the treble should likewise be a C.

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201. According to the rules which we have given for the fundamental bass, C will always be found in the chord of that note in the fundamental bass which precedes the simple dominant D. See XLVIII. XLIX. L. In the first example the dissonance is C, in the second G, and in the third E: and these notes are already in the preceding chord (4 A).

Rule II.

202. If a note of the fundamental bass be a tonic dominant, or a simple dominant, and if the dissonance be found in the treble, this dissonance in the same treble ought to descend diatonically. But if the note of the bass be a sub-dominant, it ought to rise diatonically. This dissonance, which rises or descends diatonically, is what we have called a *dissonance saved* or *resolved* (129, 130.). See LII. LIII. LIV.

203. According to the rules for the fundamental bass which we have given, the note upon which the dissonance

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ferent harmony. For instance, the tonic C, after having carried the chord C E G C, may be followed by another C which carries the chord of the seventh, provided that this chord be the chord of the tonic dominant C E G B♭. In the same manner, the tonic C may be followed by the same tonic C, which may be rendered a *sub-dominant*, by causing it to carry the chord C E G A.

A dominant, whether tonic or simple, sometimes descends or rises to another by the interval of a tritone or false fifth. For example, the dominant F carrying the chord F A C E, may be followed by another dominant B carrying the chord B D F A. This is a licence in which the musician indulges himself, that he may not be obliged to depart from the scale in which he is; for instance, from the scale of C to which F and B belong. If one should descend from F to B♭ by the interval of a just fifth, he would then depart from that scale, because B♭ is no part of it.

(3 z) There are often in the treble several notes which may, if we choose, carry no chord, and be regarded merely as notes of passage, serving only to connect between themselves the notes that do carry chords, and to form a more agreeable modulation. These notes of passage are commonly quavers. See Example XLVII. (Plate CCCLVIII). in which this modulation C D E F G, may be regarded as equivalent to this other, C E G, as D and F are no more than notes of passage. So that the bass of this modulation may be simply C G.

When the notes are of equal duration, and arranged in a diatonic order, the notes which are accented ought each of them to carry chords. Those which are unaccented, are mere notes of passage. Sometimes, however, the unaccented note may be made to carry harmony; but the duration of this note is then commonly increased by a point placed after it, which proportionably diminishes the continuance of the accented note, and makes it pass more swiftly.

When the notes do not move diatonically, they ought generally all of them to enter into the chord which is placed in the lower part correspondent with these notes.

(4 A) There is, however, one case in which the seventh of a simple dominant may be found in a modulation without being prepared. It is when, having already employed that dominant in the fundamental bass, its seventh is afterwards heard in the modulation, while the dominant is still retained. For instance, let us imagine this modulation,

C | D C B C | D;

and this fundamental bass, C | $\overset{7}{\text{D}}$ $\overset{7}{\text{G}}$ C | G;

(see example LI.); the $\overset{7}{\text{D}}$ of the fundamental bass answers to the two notes D C of the treble. The dissonance C has no need of preparation, because the note $\overset{7}{\text{D}}$ of the fundamental bass having already been employed for the D which precedes C, the dissonance C is afterwards presented, below which the chord D may be preserved, or D F A C.

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ance ought to descend or rise will always be found in the subsequent chord (4 B).

CHAP. VIII. *Of the Continued Bass and its Rules.*

‡ See *Continued Bass.*

Continued bass, what.

204. THE *continued* ‡ bass is a fundamental bass whose chords are *inverted*. We invert a chord when we change the order of the notes which compose it. For example, if, instead of the chord G B D F, we should say B D F G or D F G B, &c. the chord is inverted.

Chord inverted, how.

The ways in which a PERFECT CHORD *may be* INVERTED.

205. The perfect chord C E G C may be inverted in two different ways.

1. E G C E, which we call a chord of the *sixth*, composed of a third, a sixth, and an octave; and in this case the bass note E is marked with a 6. (See LVI.)

2. G C E G, which we call a *chord of the sixth and fourth*, composed of a fourth, a sixth, and an octave; and it is marked with a $\frac{6}{4}$. See LVII.

The perfect minor chord is inverted in the same manner.

The ways in which the CHORD *of the* SEVENTH *may be* INVERTED.

206. In the chord of the tonic dominant, as G B D F, the third major B above the fundamental note G is called a *sensible note* (77.); and the inverted chord B D F G composed of a third, a false fifth and a sixth, is called the *chord of the false fifth*, and is marked as in examples LVIII. and LIX.

The chord D F G B, composed of a third, a fourth, and a sixth, is called the *chord of the sensible sixth*, and marked as in Example LX. (4 C). In this chord, the third is minor, and the sixth major.

The chord F G B D, composed of a second, a tritone, and a sixth, is called the *chord of the tritone*, and is marked as in Example LXI. (4 D).

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207. In the chord of the simple dominant D F A C, we find,

1. F A C D, a chord of the great sixth, which is composed of a third, a fifth, and a sixth, and which is figured with a $\frac{6}{5}$. See LXII. (4 E).

2. A C D F, a chord of the lesser sixth, which is figured with a 6. See LXIII. (4 F).

3. C D F A, a chord of the second, composed of a second, a fourth, and a sixth, and which is marked with a 2. See LXIV. (4 G).

The ways in which the CHORD *of the sub-*DOMINANT *may be Inverted.*

208. The chord of the sub-dominant, as F A C D, may be inverted in three different manners; but the method of inverting it which is most in practice is the chord of the lesser sixth A C D F (LXIII.), and the chord of the seventh D F A C. See LXV.

Rules for the CONTINUED BASS.

209. The continued bass is a fundamental bass, whose chords are only inverted in order to render it more in the taste of singing, and suitable to the voice. See LXVI. in which the fundamental bass which in itself is monotonic and little suited for singing, C G C G C G C, produces, by inverting its chords, this continued bass highly proper to be sung, C B C D E F E, &c. (4 H).

The continued bass then is properly a treble with respect to the fundamental bass. Its rules immediately follow, which are properly those already given for the treble.

RULE I.

210. Every note which carries the chord of the false fifth,

(4 B) When the treble syncopates in descending diatonically, it is common enough to make the second part of the syncope carry a discord, and the first a concord. See Example LV. where the first part of the syncopated note G, is in concord with the notes C E G C, which answers to it in the fundamental bass, and where the second part is a dissonance in the subsequent chord A C E G. In the same manner, the first part of the syncopated note F is in concord with the notes D F A C, which answer to it; and the second part is a dissonance in the subsequent chord G B D F, which answers to it, &c.

(4 C) This chord is called, by English musicians, the chord of the *third* and *fourth*, and generally figured $\frac{4}{3}$.

(4 D) This chord is in England called the chord of the second and fourth, and is figured $\frac{4}{2}$.

(4 E) We are obliged to mark likewise, in the continued bass, the chord of the sub-dominant with a $\frac{6}{5}$, which in the fundamental bass is figured with a 6 alone; and this to distinguish it from the chords of the sixth and of the lesser sixth. (See examples LVI. and LXIII.). The chord of the great sixth in the fundamental bass carries always the sixth major, whereas in the continued bass it may carry the sixth minor. For instance, the chord of the seventh C E G B, gives the chord of the great sixth E G B C, thus improperly called, since the sixth from E to C is minor.

(4 F) M. Rameau has justly observed, that we ought rather to figure this lesser sixth with a $\frac{7}{4}$, to distinguish it from the sensible sixth which arises from the chord of the tonic dominant, and from the sixth which arises from the perfect chord. In the mean time he figures in his works with a 6 alone, the lesser sixths which do not arise from the tonic dominant; that is to say, he figures them as those which arise from the perfect chord; and we have followed him in that notation, though we thought with him, that it would be better to mark this chord by a particular figure.

(4 G) The chord of the seventh B D F A gives, when inverted, the chord F A B D, composed of a third, a tritone, and a sixth. The chord is commonly marked with a 6, as if the tritone were a just fourth. It is his business who performs the accompaniment, to know whether the fourth above F be a tritone or a fourth redundant. One may figure this chord thus, $\frac{4}{3}$*.

(4 H) The continued bass is proportionably adapted to singing, as the sounds which form it more scrupulously observe

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fifth, and which of consequence must be what we have called a *sensible note*, ought (77.) to rise diatonically upon the note which follows it. Thus in example LXIV. the note B, carrying the chord of the false fifth, rises diatonically upon C (41).

Rule II.

211. Every note carrying the chord of the tritone should descend diatonically upon the subsequent note. Thus in the same example LXVI. F, which carries the chord of the tritone figured with a 4+, descends diatonically upon E (art. 202.).

Rule III.

212. The chord of the second is commonly put in practice upon notes which are syncopated in descending, because these notes are dissonances which ought to be prepared and resolved (200. 302.). See the example LXVII. where the second C, which is syncopated, and which descends afterwards upon B, carries the chord of the second (4K).

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Chap IX. *Of some Licenses assumed in the Fundamental Bass.*

§ 1. *Of Broken and Interrupted Cadences.*

Broken cadence, how executed.

213. The broken cadence is executed by means of a dominant which rises diatonically upon another, or upon a tonic by a license. See, in the example LXXIV. G A, (132. and 134.)

Interrupted cadence, how formed.

214. The interrupted cadence is formed by a dominant,

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observe the diatonic order, because this order is the most agreeable of all. We must therefore endeavour to preserve it as much as possible. It is for this reason that the continued bass in Example LXV. is much more in the taste of singing, and more agreeable, than the fundamental bass which answers to it.

(41) The continued bass being a kind of treble with relation to the fundamental bass, it ought to observe the same rules with respect to that bass as the treble. Thus a note, for instance D, carrying a chord of the seventh D F A C, to which the chord of the sub-dominant F A C D corresponds in the fundamental bass, ought to rise diatonically upon E, (art. 129. N° 1. and art. 202.).

(4K) When there is a *repose* in the treble, the note of the continued bass ought to be the same with that of the fundamental bass, (see Example LXVIII.). In the closes which are found in the treble at D and C (measures second and fourth), the notes in the fundamental and continued bass are the same, viz. G for the first cadence, and C for the second. This rule ought above all to be observed in cadences which terminate a piece or a modulation.

It is necessary, as much as possible, to prevent coincidences of the same notes in the treble and continued bass, unless the motion of the continued bass should be contrary to that of the treble. For example, in the first note of the second measure in Example LXIX. D is found at the same time in the continued bass and in the treble; but the treble rises from C to D, and from D to E, whilst the bass descends from F to D, and from D to C.

Two octaves, or two fifths, in succession, must likewise be avoided. For instance, in the treble sounds G E, the bass must be prevented from sounding G E, C A, or D B; because in the first case there are two octaves in succession, E against E, and G against G; and because in the second case there are two fifths in succession, C against E, and A against G, or D against G, and B against E. This rule, as well as the preceding, is founded upon this principle, that the continued bass ought not to be a copy of the treble, but to form a different melody.

Every time that several notes of the continued bass answer to one note alone of the fundamental, the composer satisfies himself with figuring the first of them. Nay he does not even figure it if it be a tonic; and he draws above the others a line, continued from the note upon which the chord is formed. See Example LXX. (Plate CCCLIX.) where the fundamental bass C gives the continued bass C E G E; the two E's ought in this bass to carry the chord 6, and G the chord $\frac{6}{4}$: but as these chords are comprehended in the perfect chord C E G C, which is the first of the continued bass, we place nothing above C, only we draw a line over C E G E.

In like manner, in the second measure of the same example, the notes F and D of the continued bass, arising from the note G alone of the fundamental bass which carries the chord G B D F, we think it sufficient to figure F only, and to draw a line above F and D because the same harmony is used with both.

It should be remarked, that this F ought naturally to descend to E; but this note is considered as subsisting so long as the chord subsists; and when the chord changes, we ought necessarily to find the E, as may be seen by that example.

In general, whilst the same chord subsists in passing through different notes, the chord is reckoned the same as if the first note of the chord had subsisted; in such a manner, that, if the first note of the chord is, for instance, the sensible note, we ought to find the tonic when the chord changes. See Example LXXI. where this continued bass, C B D B G C, is reckoned the same with this, C, B C. (Example LXXII.).

If a single note of the continued bass answers to several notes of the fundamental bass, it is figured with the different chords which agree to it. For example, the note G in a continued bass may answer to this fundamental bass C G C, (see example LXXIII.); in this case we may regard the note G as divided into three parts, of which the first carries the chord $\frac{6}{4}$, the second the chord 7, and the third the chord $\frac{6}{4}$.

We shall repeat here, with respect to the rules of the continued bass, what we have formerly said concerning the rules of the fundamental bass in the note upon the third rule, art. 193. The rules of the continued bass have exceptions, which practice and the perusal of good authors will teach. There are likewise several other rules which might require a considerable detail, and which will be found in the *Treatise of Harmony*, by M. Rameau,

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minant which descends by a third upon another (136.). See, in the example LXXV. G E (4 L).

These cadences ought to be permitted but rarely and with precaution.

2. *Of* SUPPOSITION.

Chord by supposition, what.

215. When a dominant is preceded by a tonic in the fundamental bass, we add sometimes, in the continued bass to the chord of that dominant, a new note which is a third or a fifth below; and the chord which results from it in this continued bass is called *a chord by supposition.*

See *Supposition.*

For example, let us suppose, that in the fundamental bass we have a dominant G carrying the chord of the seventh G B D F; let us add to this chord the note C, which is a fifth below this dominant, and we shall have the total chord C G B D F, or C D F G, which is called *a chord by supposition* (4 M).

Of the different kinds of Chords by Supposition.

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216. Chords by supposition are of different kinds. For instance, the chord of the tonic dominant G B D F gives,

1. By adding the fifth C, the chord C G B D F, called *a chord of the seventh redundant*, and composed of a fifth, seventh, ninth, and eleventh. It is figured with a ♯7; see LXXVI. (4 N). This chord is not practised but upon the tonic. They sometimes leave out the sensible note, for reasons which we shall give in the note (4 O), upon the art. 219; it is then reduced to C F G D, and marked with $\frac{5}{4}$ or $\frac{5}{2}$.

These different chords what, and how figured.

2. By adding the third E, we shall have the chord E G B D F, called *a chord of the ninth*, and composed of a third, fifth, seventh, and ninth. And it is figured with a 9. This third may be added to every third of the dominant. See LXXVII.

3. If

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and elsewhere. These rules, which are proper for a complete dissertation, did not appear indispensably necessary in an *elementary essay on music*, such as the present. The books which we have quoted at the end of our *preliminary discourse* will more particularly instruct the reader concerning this practical detail.

(4 L) One may sometimes, but very rarely, cause several tonics in succession to follow one another in ascending or descending diatonically, as C E G C, D F A D, B♭ D F B♭; but, besides that this succession is harsh, it is necessary, in order to render it practicable, that the fifth below the first tonic should be found in the chord of the tonic following, as here F, a fifth below the first tonic C, is found in the chord D F A D, and in the chord B♭ D F B♭ (37. and note T).

(4 M) Though supposition be a kind of license, yet it is in some measure founded on the experiment related in the note (S), where you may see that every principal or fundamental sound causes its twelfth and seventeenth major in descending to vibrate, whilst the twelfth and the seventeenth major ascending resound: which seems to authorize us in certain cases to join with the fundamental harmony this twelfth and seventeenth in descending; or, which is the same thing, the fifth or the third beneath the fundamental sound.

Even without having recourse to this experiment, we may remark, that the note added beneath the fundamental sound, causes that very fundamental sound be heard. For instance, C added beneath G, causes G to resound. Thus G is found in some measure to be implied at C.

If the third added beneath the fundamental sound be minor, for example, if to the chord G B D F, we add the third E, the supposition is then no longer founded on the experiment, which only gives the seventeenth major, or what is the same thing, the third major beneath the fundamental sound. In this case the addition of the third minor must be considered as an extension of the rule, which in reality has no foundation in the chords emitted by a sonorous body, but is authorized by the sanction of the ear and by practical experiment.

(4 N) Many musicians figure this chord with a $\sharp\frac{7}{2}$: M. Rameau suppresses this 2, and merely marks it to be the seventh redundant by a 7♯ or ♯7. But it may be said, how shall we distinguish this chord from the seventh major, which, as it would seem, ought to be marked with a 7♯? M. Rameau answers, that there is no danger or mistake, because in the seventh major, as the seventh ought to be prepared, it is found in the preceding chord; and thus the sharp subsisting already in the preceding chord, it would be useless to repeat it.

Thus $\overset{7}{\sharp}$ D G, according to M. Rameau, would indicate D F♯ A C, G B D F♯. If we would change F♯ of the second chord into F♮, it would then be necessary to write $\overset{7}{\sharp 7\natural}$ D G. In notes such as C, whose natural seventh is major, the figure 7 preceded or followed by a sharp will sufficiently serve to distinguish the chord of the seventh redundant C G B D F, from the simple chord of the seventh C E G B, which is marked with a 7 alone. All this appears just and well founded.

(4 O) Supposition introduces into a chord dissonances which were not in it before. For instance, if to the chord E G B D, we should add the note of supposition C descending by a third, it is plain that, besides the dissonance between E and D which was in the original chord, we have two new dissonances, C B, and C D; that is to say, the seventh and the ninth. These dissonances, like the others, ought to be prepared and resolved. They are prepared by being syncopated, and resolved by descending diatonically upon one of the consonances of the subsequent chord. The sensible note alone can be resolved in ascending; but it is even necessary that this sensible note should be in the chord of the tonic dominant. As to the dissonances which are found in the primitive chord, they should always follow the common rules. (See art. 202.).

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3. If to a chord of the simple dominant, as D F A C, we should add the fifth G, we would have the chord G D F A C, called a *chord of the eleventh*, and which is figured with a $\frac{9}{4}$ or $\frac{4}{9}$. (See LXXVIII.).

OBSERVE.

Occasions when retrenchments of chords are proper.

217. When the dominant is not a tonic dominant, we often take away some notes from the chord. For example, let us suppose that there is in the fundamental bass this simple dominant E, carrying the chord E G B D: if there should be added the third C beneath, we shall have this chord of the continued bass C E G B D; but we suppress the seventh B, for reasons which shall be explained in the note upon art. 210. In this state the chord is simply composed of a third, fifth, and ninth, and is marked with a 9. See LXXIX. (4P).

218. In the chord of the simple dominant, as D F A C, when the fifth G is added, we frequently obliterate the sounds F and A, that too great a number of dissonances may be avoided, which reduces the chord to G C D. This last is composed only of the fourth and the fifth. It is called a *chord of the fourth*, and it is figured with a 4 (4Q) (see LXXX.).

219. Sometimes we only remove the note A, and then the chord ought to be figured with $\frac{7}{4}$ or $\frac{4}{7}$ (4R).

Chord of the fifth redundant what, and how figured.

220. Finally, in the minor mode, for example, in that of A, where the chord of the tonic dominant (109), is E G♯ B D; if we add to this chord the third C below, we shall have F. G♯ B D, called the *chord of the fifth redundant*, and composed of a third, a fifth redundant, a seventh and a ninth. It is figured as in LXXXI. (4S).

§ 3. *Of the* CHORD *of the* DIMINISHED SEVENTH.

Chord of the flat seventh what, and how figured.

221. In the minor mode, for instance, in that of A, E a fifth from A is the tonic dominant (109), and carries the chord E G♯ B D, in which G is the sensible note. For this chord we sometimes substitute G B♯ D F, (116), all composed of minor thirds; and which has for its fundamental sound the sensible note G♯. This chord is called a *chord of the flat* or *diminished seventh*, and is figured with a ♭7 in the fundamental bass, (see LXXXIV.); but it is always considered as representing the chord of the tonic dominant.

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222. This chord by inversion produces in the continued bass the following chords:

Chords produced in the continued bass by the what, and how figured.

1. The chord B D F G♯, composed of a third, false fifth, and sixth major. They call it the *chord of the sixth sensible and false fifth*; and it is figured as in Exam. LXXXV. (Plate CCCLX.).

2. The chord D F G♯ B, composed of a third, a tritone, and a sixth. It is called the *chord of the tritone and third minor*; and marked as in LXXXVI.

3. The chord F G♯ B D, composed of a second redundant, a tritone, and a sixth. It is called the *chord of the second redundant*, and figured as in LXXXVII. (4T).

Alteration by supposition, chord which they produce, what, and how figured.

223. Besides, since the chord G♯ B D F represents the chord E G♯ B D, it follows, that if we operate by supposition upon the first of these chords, it must be performed as one would perform it upon E G♯ B D; that is to say, that it will be necessary to add to the chord G♯ B D F, the notes C or A, which are the third or fifth below E, and which will produce,

1. By adding C, the chord C G♯ B D F, composed of a fifth redundant, a seventh, a ninth, and eleventh, which is the octave of the fourth. It is called a *chord of the fifth redundant and fourth*, and marked as in LXXXVIII.

2. By adding A, we shall have the chord A G♯ B D F, composed of a seventh redundant, a ninth, an eleventh, and a thirteenth minor, which is the octave of the sixth minor. It is called the *chord of the seventh redundant and sixth minor*, and marked as in LXXXIX. It is of all chords the most harsh, and the most rarely practised (4U).

CHAP.

(4P) Several musicians call this last chord the *chord of the ninth*; and that which, with M. Rameau, we have simply called a *chord of the ninth*, they term a *chord of the ninth and seventh*. This last chord they mark with a $\frac{9}{7}$; but the denomination and figure used by M. Rameau are more simple and can lead to no error; because the chord of the ninth always includes the seventh, except in the cases of which we have already spoken.

(4Q) In England it is figured $\frac{5}{4}$.

(4R) We often remove some dissonances from chords of supposition, either to soften the harshness of the chord, or to remove discords which can neither be prepared nor resolved. For instance, let us suppose, that in the continued bass the note C is preceded by the sensible note B carrying the chord of the false fifth, and that we should choose to form upon this note C the chord C E G B D, we must obliterate the seventh B, because in retaining it we should destroy the effect of the sensible note B, which ought to rise to C.

In the same manner, if to the harmony of a tonic dominant G B D F, one should add the note by supposition C, it is usual to retrench from this chord the sensible note B; because, as the D ought to descend diatonically to C, and the B to rise to it, the effect of the one would destroy that of the other. This above all takes place in the *suspension*, concerning which we shall presently treat.

(4S) *Supposition* produces what we call *suspension*; and which is almost the same thing. Suspension consists in retaining as many as possible of the sounds in a preceding chord, that they may be heard in the chord which succeeds. For instance, in Example LXXXII. the C bearing ♯7 is a supposition; but in Example LXXXIII. it is a suspension, because it suspends or retards the perfect chord C E G C which the ear expects after the tonic dominant G B D F.

(4T) The chord of the diminished seventh, and the three derived from it, are termed *chords of substitution*. They are in general harsh, and proper for imitating melancholy objects.

(4U) As the chord of the diminished seventh G♯ B D F, and the chord of the tonic dominant E G♯ B D, only differ

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CHAP. X. *Of some licenses used in the Treble and Continued Bass.*

Licenses.

224. SOMETIMES in a treble, the dissonance which ought to have been resolved by descending diatonically upon the succeeding note, instead of descending, on the contrary rises diatonically: but in that case, the note upon which it ought to have descended must be found in some of the other parts. This license ought to be rarely practised.

In like manner, in a continued bass, the dissonance in a chord of the sub-dominant inverted, as A in the chord A C E G, inverted from C E G A, may sometimes descend diatonically instead of rising as it ought to do, art. 129. N° 2.; but in that case the note ought to be repeated in another part, that the dissonance may be there resolved in ascending.

License ad.

225. Sometimes likewise, to render a continued bass more agreeable by causing it to proceed diatonically, we place between two sounds of that bass a note which belongs to the chord of neither. See Example XCII. in which the fundamental bass G C produces the continued bass G A B G C, where A is added on account of the diatonic modulation. This A has a line drawn above it, to show its resolution by passing under the chord G B D F.

In the same manner, (see XCIII.) this fundamental bass C F may produce the continued bass C D E C F, where the note D, which is added, passes under the chord C E G C.

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CHAP. XI. *Containing the Method of finding the Fundamental Bass when the continued Bass is figured.*

How to find the fundamental bass when the continued is figured.

226. As the continued bass alone appears in practical compositions, it becomes necessary to know how to find the fundamental bass when the continued bass is figured. This problem may be easily solved by the following rules.

227. 1. Every note which has no figure in the continued bass, ought to be the same, and without a figure in the fundamental bass; it is either a tonic, or reckoned such (4 X).

2. Every note which in the continued bass carries a 6, ought in the fundamental bass to give its third below not figured *, or its fifth below marked with a 7. We shall distinguish these two cases below. See LVI. and the note (4 Y).

* See *Figured*.

3. Every note carrying $\frac{6}{4}$ gives in the fundamental bass its fifth below not figured. See LVII.

4. Every note figured with a 7, or a $\not 7$, is the same in both basses, and with the same figure (4 Y).

5. Every note figured with a 2 gives in the fundamental bass the diatonic note above figured with a 7. See LXIV. (4 Z).

6. Every note marked with a 4 gives in the fundamental

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differ one from the other by the notes E and F; one may form a diatonic modulation of these two notes, and then the fundamental bass does nothing but pass from the tonic dominant to the sensible note, and from that note to the tonic dominant, till it arrives at the tonic. (See XC.).

For the same reason, as the chord of the diminished seventh G♯ B D F, and the chord B D F A, which carries the fifth B of the tonic dominant E, only differs by the sensible note G♯, and the tonic A; one may sometimes, while the treble modulates G♯ A G♯ A G♯ A, ascend in the fundamental bass, from the bass note to the third above, provided one descend at last from thence to the tonic dominant, and from thence to the tonic; (see XCI). This and the preceding examples are licenses.

(4 X) We say a tonic, or *reckoned such*, because it may perhaps be a dominant from which the dissonance has been removed. But in that case one may know that it is a real dominant by the note which precedes it. For instance, if the note G, carrying a perfect chord, is preceded by D a simple dominant, carrying the chord D F A C, that note G is not a real tonic; because, in order to this, it would have been necessary that D should have been a tonic dominant, and should have carried the chord D F♯ A C; and that a simple dominant, as D, carrying the chord D F A C, should only naturally descend to a dominant, (art. 194.).

(4 Y) Sometimes a note which carries a 7 in the continued bass, gives in the fundamental bass its third above figured with a 6. For example, this continued bass $\overset{7}{A}\ \overset{6}{B}$ C gives this fundamental bass $\overset{6}{C}\ \overset{7}{G}$ C; but in this case it is necessary that the note figured with a 6 should rise by a fifth, as we see here C rise to G.

(4 Z) A note figured with a 2, gives likewise sometimes in the fundamental bass its fourth above, figured with a 6; but it is necessary in that case that the note figured with a 6, may even here rise to a fifth. (See note (4 Y).

These variations in the fundamental bass, as well in the chord concerning which we now treat, as in the chord figured with a 7, and in two others which shall afterwards be mentioned (art. 228. and 229.), are caused by a deficiency in the signs proper for the chord of the sub-dominant, and for the different arrangements by which it is inverted.

M. l'Abbé Roussier, to redress this deficiency, had invented a new manner of figuring the continued bass. His method is most simple for those who know the fundamental bass. It consists in expressing each chord by only signifying the fundamental sound with that letter of the scale by which it is denominated, to which is joined a 7 or $\not 7$, or a 6, in order to mark all the discords. Thus the fundamental chord of the seventh D F A C is expressed by a $\overset{7}{D}$; and the same chord, when it is inverted from that of the sub-dominant F A C D, is characterized by $\overset{6}{F}$; the chord of the second C D F A, inverted from the dominant D F A C, is likewise represented by $\overset{7}{D}$; and the same chord C D F A, inverted from that of the sub-dominant F A C D, is signified by $\overset{6}{F}$; the case is the

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mental bass the diatonic note above, figured with a 7. (See LXI.)

7. Every note figured with a ♯ gives its third below figured with a 7. (See LVIII.).

8. Every note marked with a ♭ gives the fifth below marked with a 7; (see LX.) and it is plain by art. 187. that in the chord of the seventh, of which we treat in these three last articles, the third ought to be major, and the seventh minor, this chord of the seventh being the chord of the tonic dominant. (See art. 102.)

9. Every note marked with a 9 gives its third above figured with a 7. (See LXXVII. and LXXIX.).

10. Every note marked with a $\frac{9}{4}$ gives the fifth above figured with a 7. (See LXXVIII.)

11. Every note marked with a ✻5, or with a +5, gives the third above figured with a $\overset{7}{\text{✻}}$. (See LXXXI.).

12. Every note marked with a ✻7 gives a fifth above figured with a 7, or with a $\overset{7}{\text{✻}}$. (See LXXVI.). It is the same case with the notes marked $\frac{7}{4}$, $\frac{5}{4}$, or $\frac{5}{2}$: which shows a retrenchment, either in the complete chord of the eleventh, or in that of the seventh redundant.

13. Every note marked with a 4 gives a fifth above figured with a 7, or a $\overset{7}{\text{✻}}$. (See LXXX.)

14. Every note marked with a ✻6 gives the third minor below, figured with a ♯. (See LXXXV.).

15. Every note marked with a $\overset{4}{\flat}$ gives the tritone above figured with a ♯. (See LXXXVI.).

16. Every note marked with a ✻2 gives the second redundant above, figured with a ♯. (See LXXXVII.).

17. Every note marked with a ✻$\frac{4}{3}$ gives the fifth redundant above, figured with a ♯. (See LXXXVIII.).

18. Every note marked with a $\frac{✻7}{\flat 6}$ gives the seventh redundant above, figured with a ♯ (See LXXXIX.). (5 A).

REMARK.

A difficulty in finding the fundamental bass.

228. We have omitted two cases, which may cause some uncertainty.

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The first is that where the note of the continued bass is figured with a 6. We now present the reason of the difficulty.

Suppose we should have the dominaut $\overset{7}{\text{D}}$ in the fundamental bass, the note which answers to it in the continued bass may be A carrying the figure 6 (see LXIV.); that is to say, the chord A C D F: now if we should have the subdominant $\overset{6}{\text{F}}$ in the fundamental bass, the subdominant might produce in the continued bass, the same note A figured with a 6. When therefore we find in the continued bass a note marked with a 6, it appears at first uncertain whether we should place in the fundamental bass the fifth below marked with a 7, or the third below marked with a 6.

Another

229. The second case is that in which the continued bass is figured with a $\frac{6}{7}$. For instance, if there should be found $\overset{6}{\underset{7}{\text{F}}}$ in the continued bass, we may be ignorant whether we ought to insert in the fundamental bass F marked with a 6, or D figured with a 7.

Solution.

230. This difficulty may be removed by leaving for an instant this uncertain note in suspense, and in examining the succeeding note of the fundamental bass; for if that note be in the present case a fifth above F, that is to say, if it be C in this case, and in this alone, we may place $\overset{6}{\text{F}}$ in the fundamental bass. It is a consequence of this rule, that in the fundamental bass every sub-dominant ought to rise by a fifth (195.).

CHAP. XII. *What is meant by being in a Mode or Tone.*

Method of determining the mode in which we are.

231. IN the first part of this treatise (chap. vi.) we have explained, how by the means of the note C, and of its two-fifths G and F, one in ascending, which is called a *tonic dominant*, the other in descending which is called a *sub-dominant*, the scale C D E F A B C may be found: the different sounds which form this scale compose

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the same when the chords are differently inverted. By this means it would be impossible to mistake either with respect to the fundamental bass of a chord, or with respect to the note which forms its dissonance, or with respect to the nature and species of that discord.

(5 A) We may only add, that here, and in the preceding articles of the text, we suppose, that the continued bass is figured in the manner of M. Rameau. For it is proper to observe, that there are not, perhaps, two musicians who characterize their chords with the same figures; which produce a great inconveniency to the person who plays the accompaniments: but here we do not treat of accompaniments. We prefer the continued basses of M. Rameau to all the others, as by them the fundamental bass will be most easily discovered.

M. Rameau only marks the lesser sixth by a 6 without a line, when this lesser sixth does not result from the chord of the tonic dominant; in such a manner that the 6 renders it uncertain whether in the fundamental bass we ought to choose the third or the fifth below; but it will be easy to see whether the third or the fifth is signified by that figure. This may be distinguished, 1. In observing which of the two notes is excluded by the rules of the fundamental bass. 2. If the two notes may with equal propriety be placed in the fundamental bass, the preference must be determined by the tone or mode of the treble in that particular passage. In the following chapter we shall give rules for determining the mode (note 3 Z).

There is a chord of which we have not spoken in this enumeration, and which is called the *chord of the sixth redundant*. This chord is composed of a note, of its third major, of its redundant fourth or tritone, and its redundant sixth, as F A B D✻. It is marked with a 6✻. It appears difficult to find a fundamental bass for this chord; nor is it indeed much in use amongst us. (See the note upon the art. 115.)

This chord is called in England the chord of the *extreme sharp sixth*. When accompanied by the third only, it is called the *Italian sixth*. When the fifth is substituted for the tritone, it has been called the *German sixth*.

compose the *major mode* of C, because the third E above C is major. If therefore we would have a modulation in the major mode of C, no other sounds must enter into it than those which compose this scale; in such a manner that if, for instance, we should find F♯ in this modulation, this F♯ discovers to us that we are not in the mode of C, or at least that, if we have been in it, we are no longer so.

232. In the same manner, if we form this scale in ascending A B C♯ D E F♯ G♯ A, which is exactly similar to the scale C D E F G A B C of the major mode of C, this scale, in which the third from A to C♯ is major, shall be in the major mode of A; and if we incline to be in the minor mode of A, we have only to substitute for C sharp C natural; so that the major third A C♯ may become minor A C: we shall have then

A B C D E F♯ G♯ A,

which is (85.) the scale of the minor mode of A in ascending; and the scale of the minor mode of A in descending shall be (90.),

A G F E C D B A,

in which the G and F are no longer sharp. For it is a singularity peculiar to the minor mode, that its scale is not the same in rising as in descending (89.).

Hence it appears what sharps and flats should be placed at the cleff in the major mode of A, and why they are omitted in the minor mode in descending.

233. This is the reason why, when we wish to begin a piece in the major mode of A, we place three sharps at the cleff upon F, C, and G; and on the contrary, in the minor mode of A, we place none, because the minor mode of A, in descending, has neither sharps nor flats.

234. As the scale contains twelve sounds, each distant from the other by the interval of a semitone, it is obvious that each of these sounds can produce both a major and a minor mode, which constitute 24 modes upon the whole. Of these we shall immediately give a table, which may be very useful to discover the mode in which we are.

Modes 24 in the whole.

A TABLE of the DIFFERENT MODES.

Major Modes.

Maj. Mode.

of C;	C, D, E, F, G, A, B, c.
of G;	G, A, B, c, d, e, f♯, g.
of D;	D, E, F♯, G, A, B, c♯, d.
of A;	A, B, c♯, d, e, f♯, g♯, a.
of E;	E, F♯, G♯, A B c♯, d♯, e.
of B;	B, c♯, d♯, e, f♯, g♯, a♯, b.
Of F♯.	F♯, G♯, A♯, B, c♯, d♯, e♯, f♯ (5 B).
Of C♯, or D♭;	D♭, E♭, F, G♭, A♭, B♭, c, d♭.
Of G♯, or A♭;	A♭, B♭, c, d♭, e♭, f, g, a♭.
Of D♯, or E♭;	E♭, F, G, A♭, B♭, c, d, e♭.
of A♯, or B♭;	B♭, C, D, E♭, F, G, A, B♭.
of E♯, or F♮;	F, G, A, B♭, c, d, e, f.
of B♯, or C♮;	C, D, E, F, G, A, B, e.

(See Ex. xciv.).

Minor Modes.

Of A.

In descending.	A G F E D C B A.
In rising.	A B C D E F♯ G♯ A.

Of E.

In descending.	e d c B A G F♯ E.
In rising.	E F♯ G A B c♯ d♯ e.

Of B.

In descending.	B A G F♯ E D C♯ B.
In rising.	B C♯ D E F♯ G♯ A♯ B.

Of F♯.

In descending.	f♯ e d c♯ B A G♯ E♯.
In rising.	F♯ G♯ A B C♯ d♯ c♯ f♯.

Of C♯.

In descending.	C♯ B A G♯ F♯ E D♯ C♯.
In rising.	C♯ D♯ E F♯ G♯ A♯ B♯ C♯.

Of G♯ or A♭.

In descending.	g♯ f♯ e d♯ c♯ B A♯ G♯.
In rising.	A♭ B♭ C♭ d♭ e♭ f g a♭.

Of D♯ or E♭.

In descending.	e♭ d♭ c♭ B♭ A♭ G♭ F E♭.
In rising.	E♭ F G♭ A♭ B♭ c d e♭.

Of A♯ or B♭.

In descending.	B♭ A♭, G♭ F E♭ D♭ C B♭.
In rising.	B♭ C D♭ E♭ F G A B♭.

(5 B) The major mode of F♯, of C♯, and of G♯, are not much practised.

When a piece begins upon C♯, there ought to be seven sharps placed at the cleff: but it is more convenient only to place five flats, and to suppose the key D♭, which is almost the same thing with C♯. For this reason we substitute here the mode of D♭, for that of C♯.

It is still much more necessary to substitute the mode of A♭ for that of G♯; for the scale of the major mode of G♯ is,

G♯, A♯, B♯, C♯, d♯, e♯, g, g♯,

in which it appears that there are at the same time both a 'g♮' and a 'g♯': it would then be necessary, even at the same time, that upon G there should and should not be a sharp at the cleff; which is inconsistent. It is true that this inconvenience may be avoided by placing a sharp upon G at the cleff, and by marking the note G with a natural through the course of the music wherever it ought to be natural; but this would become troublesome, above all if there should be occasion to transpose. In the article 236. we shall give an account of transposition. We might likewise in this series, instead of G natural, which is the note immediately before the last, substitute F♯♯, that is to say, F twice sharp: which, however, is not absolutely the same sound with G natural, especially upon instruments whose scales are fixed, or whose intervals are invariable. But in that case two sharps must be placed at the cleff upon F, which would produce another inconvenience. But by substituting A♭ for G♯, the trouble is eluded.

The double sharp, however, is incidentally used, when in a composition in the key of F♯ there is an occasional modulation into the dominant of that key, and it is distinguished by the character × or ♯♯.

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Of E♯ or F♮

In descending. f F e♭ d♭ c B♮ A♭ G F.
In rising. F G A♭ B♭ c d e f.

Of C.

In descending. c B♭ A♭ G F E♭ D C.
In rising. C D E♭ F G A B c.

Of G.

In descending. g f e♭ d C B♭ A G.
In rising. G A B♭ c d e f♯ g.

Of D.

In descending. d c B♭ A G F E D.
In rising. D E F G A B c♯ d (5c).

crowded with sharps and flats little practised.

235. These then are all the modes, as well major as minor. Those which are crowded with sharps and flats are little practised, as being extremely difficult in execution.

236. Hence it follows,

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1. That when there are neither sharps nor flats at the cleff, the piece begins in the major mode of C, or in the minor mode of A.

Results.

2. That when there is one sharp, it will always be placed upon F, and that the piece begins in the major mode of G, or in the minor of E, in such a manner that it may be sung as if there were no sharp, by singing B instead of F♯, and in singing the tune as if it had been in another cleff. For instance, let there be a sharp upon F in the cleff of G upon the first line; one may then sing the tune as if there were no sharp; and as if, instead of the cleff of G upon the first line, it were the cleff of C; for the F♯, when changed into B, will require that the cleff of G should be changed to the cleff of C, as may be easily seen. This is what we call *transposition* (5 D).

237. It is evident, that when F♯ is changed into B,

See *Transposition*.

(5 C) We have already seen, that in each mode, the principal note is called a *tonic;* that the fifth above that note is called a *tonic dominant*, or the *dominant of the mode*, or simply a *dominant;* that the fifth below the tonic, or, what is the same thing, the fourth above that tonic, is called a *sub-dominant;* and in short, that the note which forms a semitone below the tonic, and which is a third major from the dominant, is called a *sensible note*. The other notes have likewise in every mode particular names which it is advantageous to know. Thus a note which is a tone immediately above the tonic, as D in the mode of C, and B in that of A is termed a *super-tonic;* the following note, which is a third major or minor from the tonic, according as the chord is major or minor, such as E in the major mode of C, and C in the minor mode of A, is called a *mediant;* and the note which is a tone above the dominant, such as A, in the mode of C, and F♯ in that of A, is called a *super-dominant*.

(5 D) Though our author's account of this delicate operation in music will be found extremely just and compendious; though it proceeds upon simple principles, and comprehends every possible contingency; yet as the manner of thinking upon which it depends may be less familiar to English readers, if not profoundly skilled in music, it has been thought proper to give a more familiar, though less comprehensive, explanation of the manner in which *transposition* may be executed.

It will easily occur to every reader, that if each of the intervals through the whole diatonic series were equal, in a mathematical sense, it would be absolutely indifferent upon what note any air were begun, if within the compass of the gammut; because the same equal intervals must always have the same effects. But since, besides the natural semitones, there is another distinction of diatonic intervals into *greater* and *lesser tones;* and since these vary their positions in the series of an octave, according as the note from whence you begin is placed, that note is consequently the best key for any tune whose natural series is most exactly correspondent with the intervals which that melody or harmony requires. But in instruments whose scales are fixed, notwithstanding the temperament and other expedients of the same kind, such a series is far from being easily found, and is indeed in common practice almost totally neglected. All that can frequently be done is, to take care that the ear may not be sensibly shocked. This, however, would be the case, if, in transposing any tune, the situation of the semitones, whether natural or artificial, were not exactly correspondent in the series to which your air must be transposed, with their positions in the scale from which you transpose it. Suppose, for instance, your air should begin upon C, requiring the natural diatonic series through the whole gammut, in which the distance between E and F, as also that between B and C, is only a semitone. Again, suppose it necessary for your voice, or the instrument on which you play, that the same air should be transposed to G, a fifth above its former key; then because in the first series the intervals between the third and the fourth, seventh and eighth notes, are no more than semitones, the same intervals must take the same place in the octave to which you transpose. Now, from G, the note with which you propose to begin, the three tones immediately succeeding are full; but the fourth C is only a semitone; it may therefore be kept in its place. But from F, the seventh note above, to G, the eighth, the interval is a full tone, which must consequently be redressed by raising the F a semitone higher. Thus the situations of the semitonic intervals in both octaves will be correspondent; and thus, by conforming the positions of the semitones in the octave to which you transpose, with those in the octave in which the original key of the tune is contained, you will perform your operation with as much success as the nature of fixed scales can admit.

The order to be observed in these alterations of the intervals, is deduced from the relation which the fifth ascending and descending bear to the fundamental (art. 34, 35.); and therefore the farther we depart from the natural fundamental C by a series of fifths ascending or descending, the alterations, and consequently the number sharps or flats indicating them, will be the greater.

Thus if G, which is the perfect fifth ascending from , therefore the note most nearly allied to C (art. 39, 40.),

be

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All the modes reducible to the major of C and the minor of A.

B, G must be changed into C, and E into A. Thus, by transposition, the air has the same melody as if it were in the major mode of C, or in the minor mode of A. The major mode then of G, and the minor of E, are by transposition reduced to those of C major, and of A minor. It is the same case with all the other modes (5 E).

Chap. XIII. *To find the Fundamental Bass of a given Modulation.*

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Method of finding a fundamental bass to a given air not difficult, and why.

238. As we have reduced to a very small number the rules of the fundamental bass, and those which in the treble ought to be observed with relation to this bass, be taken for a fundamental, F, which is the seventh of the scale of G, must be made sharp, that it may be a whole tone from the sixth E, and only a semitone from the key note G, according to the laws of the diatonic scale (art. 77.). See Ex. XCIV. 1. 2.

Again, if D, the perfect fifth ascending from G, and the second in the series of progressive fifths ascending from C, be used as a fundamental, C, which is the seventh of the scale of D, must, to render it the sensible or leading note (art. 77.) be made sharp in addition to F; so that in the scale of D, there are two sharps, F and C. See Ex. XCIV. (3.)

If A, the perfect fifth above D, and the third in the series of fifths ascending from C, be the fundamental, the seventh G must, in addition to F and C, be made sharp, for the same reason (4.); and so on, on the scale of E, which is next in order, F, C G, and D, must be sharp (5.): in that of B, the sharps must be F, C, G, D, and A (6.).

The perfect fifth above B is F𝄪, and in that scale F, C, G, D, A, and E, must be sharp (7.). And in the next scale C𝄪 all the notes of the system are sharp (8.).

This, for the reasons mentioned in the note (5 B), is the last scale to which we can properly go by the progressions of fifths ascending.

Returning to the natural scale of C, if instead of assuming G, the perfect fifth above, for a fundamental, we take F, the perfect fifth below; B, which is the fourth note above F, and forms a *tritone* or sharp fourth to it, must, to become a perfect fourth, according to the laws of the diatonic scale, (art. 60.) be made flat 12.).

Proceeding with the series of fifths descending, if B♭, which is the perfect fifth below F, be taken for a fundamental; E, which, in its natural state, is the tritone or sharp fourth to B♭, must, to become the diatonic fourth (art. 60.), also be rendered flat (11.).

If E♭, which is the perfect fifth below B♭, and the third in the series of fifths descending from C, be made the fundamental, A, the sharp fourth, must, to become the diatonic fourth, be made flat, and the flats marked at the cleff are B, E, and A (10.).

To form the next scale in the series of fifths descending, which is that of A flat, D must be flattened; and B, E, A, and D, are marked flat at the cleff (9.).

The next scale, that of D flat, is formed by flattening G, and adding its flat to the others at the cleff (8.). This is the scale recommended to be used rather than that of C𝄪. (See note 5 B).

We do not proceed farther with the series of fifths descending, since the next scale, that of G♭, would just or very nearly exhibit the sounds already represented by the scale of F𝄪 (7.). This scale is, however, sometimes written in the key of G flat, and we even meet with the scale of its fifth below, C flat, and, with an occasional modulation from that key into its fifth below, E flat, where B being necessarily twice flattened, is distinguished by this character $\frac{b}{b}$, or ♭♭, called a double flat.

We have thus seen, 1st, That each of the notes of the diatonic scale of C, and each of the semitones into which the whole tones of that scale are divided, may be taken for the fundamental note of a diatonic scale, called the *scale of that note*. 2dly, That the notes of the natural scale are more or less altered, as the note assumed for a fundamental is more or less distant from C, in a progression of fifths ascending or descending. 3dly, That in the progression by fifths ascending, the notes are altered by sharps, and in the progression by fifths descending, the alterations are by flats. 4thly, That in the alteration by sharps, the last sharp is always on the seventh or *sensible* note of the scale; and where there are more than one, is always on the fifth above the sharp immediately preceding; and in the alteration by flats, the last flat is always on the fourth of the scale; and where there are more than one, is always on the fifth below the flat immediately preceding.

The signatures of sharps and flats at the cleffs, belonging to the twelve major scales, are also used for their relative minor scales. The occasional elevation and depression of the sixths and sevenths of the minor scales, are denoted by occasional sharps and flats placed before these notes.

(5 E) Many musicians, and amongst others the ancient musicians of France, as Lulli, Campra, &c. place one flat less in the minor mode: so that in the minor mode of D, they place neither sharp nor flat at the cleff; in the minor mode of G, one flat only; in the minor mode of C, two flats, &c.

This practice in itself is sufficiently indifferent, and scarcely merits the trouble of a dispute. Yet the method which we have here described, according to M. Rameau, has the advantage of reducing all the modes to two: and besides it is founded upon this simple and very general rule, That in the major mode, we must place as many sharps or flats at the cleff, as are contained in the diatonic scale of that mode in ascending; and in the minor mode, as many as are contained in that same scale in descending.

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bass, it should no longer be difficult to find the fundamental bass of a given modulation, nay, frequently to find several; for every fundamental bass will be legitimate, when it is formed according to the rules which we have given (chap. vi.); and that, besides this, the dissonances which the modulation may form with this bass, will both be prepared, if it is necessary that they should be so, and always resolved (5 F).

Difficulty of assigning general rules for ascertaining the mode of a melody whose fundamental base is sought.

239. It is of the greatest utility in searching for the fundamental bass, to know what is the tone or mode of the melody to which that bass should correspond.—But it is difficult in this matter to assign general rules, and such as are absolutely without exception, in which nothing may be left that appears indifferent or discretionary; because sometimes we seem to have the free choice of referring a particular melody either to one mode or another. For example, this melody G C may belong to all the modes, as well major as minor, in which G and C are found together; and each of these two sounds may even be considered as belonging to a different mode.

Reasons why we may proceed without the knowledge of the mode, and how we may be preserved from deviating in composition.

240. We may sometimes, as it should seem, operate without the knowledge of the mode, for two reasons; 1. Because, since the same sounds belong to several different modes, the mode is sometimes considerably undetermined; above all, in the middle of a piece, and during the time of one or two bars. 2. Without giving ourselves much trouble about the mode, it is often sufficient to preserve us from deviating in composition, if we observe in the simplest manner the rules above prescribed (chap. vi.) for the procedure of the fundamental bass.

Knowledge of the mode in beginning a piece indispensable, and why.

241. In the mean time, it is above all things necessary to know in what mode we operate at the beginning of the piece, because it is indispensable that the fundamental bass should begin in the same mode, and that the treble and bass should likewise end in it; nay, that they should even terminate in its fundamental note, which in the mode of C is C, and A in that of A, &c. Besides, in those passages of the modulation where there is a cadence, it is generally necessary that the mode of the fundamental bass should be the same with that of the part to which it corresponds.

Investigation of the mode continued.

242. To know upon what mode or in what key a piece commences, our inquiry may be entirely reduced to distinguish the major mode of C from the minor of A. For we have already seen (art. 236. and 237.), that all the modes may be reduced to these two, at least in the beginning of the piece. We shall now therefore give a detail of the different means by which these two modes may be distinguished.

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Means by which the modes may be determined.

1. From the principal and characteristical sounds of the mode, which are C E G in the one, and A C E in the other; so that if a piece should, for instance, begin thus, A C E A, it may be almost constantly concluded, that the tone or mode is in A minor, although the notes A C E belong to the mode of C.

2. From the sensible note, which is B in the one, and G♯ in the other; so that if G♯ appears in the first bars of a piece, we may be certain that we are in the mode A.

3. From the adjuncts of the mode, that is to say, the modes of its two-fifths, which for C are F and G, and D and E for A. For example, if after having begun a melody by some of the notes which are common to the modes of C and of A (as E D E F E D C B C), we should afterwards find the mode of G, which we ascertain by the F♯, or that of F which we ascertain by the B♭ or C♮, we may conclude that we have begun in the mode of C; but if we find the mode of D, or that of E, which we ascertain by B♮, C♯, or D♯, &c. we conclude from thence that we have begun in the mode of A.

4. A mode is not usually changed, especially in the beginning of a piece, unless in order to pass into one or other of the modes most relative to it, which are the mode of its fifth above, and that of its third below, if the original mode be major, or of its third above if it be minor. Thus, for instance, the modes which are most intimately relative to the major mode of C, are the major mode of G, and that of A minor. From the mode of C we commonly pass either into the one or the other of these modes; so that we may sometimes judge of the principal mode in which we are, by the relative mode which follows it, or which goes before it, when these relative modes are decisively marked. Besides these two relative modes, there are likewise two others into which the principal mode may pass, but less frequently, viz. the mode of its fifth below, and that of its third above, as F and E for the mode of C (5 G).

5. The modes may still be likewise distinguished by the cadences of the melody. These cadences ought to occur at the end of every two, or at most of every four bars, as in the fundamental bass: now the note of the fundamental bass which is most suitable to these closes,

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(5 F) We often say, *that we are upon a particular key* or *scale*, instead of saying *that we are in a particular mode*. The following expressions therefore are synonymous; *such a piece is in* C *major*, or *in the mode of* C *major*, or *in the key of* C *major*, or in the scale of C *major*.

(5 G) It is certain that the minor mode of E has an extremely natural connection with the mode of C, as has been proven (art. 92.) both by arguments and by examples. It has likewise appeared in the note upon the art. 93. that the minor mode of D may be joined to the major mode of C: and thus in a particular sense, this mode may be considered as relative to the mode of C, but it is still less so than the major modes of G and F, or than those of A and E minor; because we cannot immediately, and without licence, pass in a fundamental bass from the perfect minor chord of C to the perfect minor chord of D; and if you pass immediately from the major mode of C to the minor mode of D in a fundamental bass, it is by passing, for instance, from the tonic C, or from E G C, to the tonic dominant of D, carrying the chord A C♯ E G, in which there are two sounds, E G, which are found in the preceding chord, (Ex. XCV.) or otherwise from C E G C to G B♭ D E, a chord of the sub-dominant in the minor mode of D, which chord has likewise two sounds, G and E, in common with that which went immediately before it. See Ex. XCVI.

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closes *, is always easy to be found. For the sounds which occur in the treble, M. Rameau may be consulted, p. 54. of his *Nouveau Systeme de Musique theorique et pratique* (5 H).

* See *Cadence.*

When the mode is ascertained, by the different means which we have pointed out, the fundamental bass will cost little pains. For in each mode there are three fundamental sounds.

Having ascertained the mode, the fundamental bass not difficult.

1. The tonic of the mode, or its principal sound, which carries always the perfect chord major or minor, according as the mode itself is major or minor.

Major mode of C, C E G 'c'.
Minor mode of A, A C E A.

2. The tonic dominant, which is a fifth above the tonic, and which, whether in the major or minor mode, always carries a chord of the seventh, composed of a third major followed by two thirds minor.

Tonic dominant.
Major mode of C, G B D 'f'.

Tonic dominant.
Minor mode of A, E G♯ B 'd'.

3. The sub-dominant, which is a fifth below the tonic, and which carries a chord composed of a third, fifth, and sixth major, the third being either greater or lesser, according as the mode is major or minor.

Sub-dominant.
Major mode of C, F A C 'd'.
Minor mode of A, D F A B.

These three sounds, the tonic, the tonic dominant, and the sub-dominant, contain in their chords all the notes which enter into the scale of the mode; so that when a melody is given, it may almost always be found which of these three sounds should be placed in the fundamental bass, under any particular note of the upper part. Yet it sometimes happens that not one of these notes can be used. For example, let it be supposed that we are in the mode of C, and that we find in the melody these two notes A B in succession; if we confine ourselves to place in the fundamental bass one of the three sounds C G F, we shall find nothing for the sounds A and B but this fundamental bass $\overset{6}{F}\,\overset{7}{G}$; now such a succession as $\overset{6}{F}$ to $\overset{7}{G}$ is prohibited by the fifth rule for the fundamental bass, according to which every sub-dominant, as F, shall rise by a fifth; so that $\overset{6}{F}$ can only be followed by C in the fundamental bass, and not by $\overset{7}{G}$.

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To remedy this, the chord of the sub-dominant F A C 'd' must be inverted into a fundamental chord of the seventh, in this manner, D F A 'c', which has been called the *double employment* (art. 105.) because it is a secondary manner of employing the chord of the sub-dominant. By these means we give to the modulation A B this fundamental bass $\overset{7}{D}\,\overset{7}{G}$; which procedure is agreeable to rules. See Ex. XCVII.

Here then are four chords, C E G 'c', G B D 'f', F A C 'd', D F A 'c', which may be employed in the major mode of C. We shall find in like manner, for the minor mode of A, four chords.

A C 'e a', E G♯ B 'd',
D F A B, B D 'f a'.

And in this mode we sometimes change the last of these chords into B D 'f♯ a', substituting the 'f♯' for 'f♮'. For instance, if we have this melody in the minor mode of A, E F♯ G♯ A, we would cause the first note E to carry the perfect chord A C E A; the second note F♯ to carry the chord of the seventh B D F♯ A; the third note G♯, the chord of the tonic dominant E G♯ B D, and the last the perfect chord A C E A. See Ex. XCVIII.

On the contrary, if this melody is given always in the minor mode, A A G♯ A, the second A being syncopated, it might have the same bass as the modulation E F♯ G♯ A, with this difference alone, that F♮ might be substituted for F♯ in the chord B D F♯ A, the better to mark out the minor mode. See Exam. XCIX.

Besides these chords which we have just mentioned, and which may be regarded as the principal chords of the mode, there are still a great many others; for example, the series of dominants,

$$C\,\overset{7}{A}\,\overset{7}{D}\,\overset{7}{G}\,\overset{7}{C}\,\overset{7}{F}\qquad B\,\overset{7}{E}\,\overset{7}{A}\,\overset{7}{D}\,\overset{7}{G}\,C,$$

which are terminated equally in the tonic C, either entirely belong, or at least may be reckoned as belonging (51) to the mode of C; because none of these dominants are tonic dominants, except G, which is the tonic dominant of the mode of C; and besides, because the chord of each of these dominants forms no other

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(5 H) All these different manners of distinguishing the modes ought, if we may speak so, to give mutual light and assistance one to the other. But it often happens, that one of these signs alone is not sufficient to determine the mode, and may even lead to error. For example, if a piece of music begins with these three notes, E C G, we must not with too much precipitation conclude from thence that we are in the major mode of C, although these three sounds, E C G, be the principal and characteristical sounds in the major mode of C: we may be in the minor mode of E, especially if the note E should be long.

(5 I) I have said, *that they may be reckoned as belonging to this mode*, for two reasons: 1. Because, properly speaking, there are only three chords which essentially and primitively belong to the mode of C, viz. C carrying the perfect chord, F carrying that of the sub-dominant, and G that of the tonic dominant, to which we may join the chord of the seventh, D F A C (art. 105.): but we here regard *as extended* the series of dominants in question, as belonging to the mode of C, because it preserves in the ear the impression of that mode. 2. In a series of dominants, there are a great many of them which likewise belong to other modes; for instance, the simple dominant A belongs naturally to the mode of G, the simple dominant B to that of A, &c. Thus it is only improperly, and by way of extension, as I have already said, that we regard here these dominants as belonging to the mode of C.

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other sounds than such as belong to the scale of C. See Ex. c.

But if we were to form this fundamental bass,

$$\overset{7}{C}\ \overset{7}{A}\ \overset{7}{D}\ \overset{7}{G}\ \overset{7\flat}{C},$$

considering the last C as a tonic dominant in this manner, C E G B♭; the mode would then be changed at the second C, and we should enter into the mode of F, because the chord C E G B♭ indicates the tonic dominant of the mode of F; besides, it is evident that the mode is changed, because B♭ does not belong to the scale of C. See Ex. CI.

In the same manner, were we to form this fundamental bass

$$C\ \overset{7}{A}\ \overset{7}{D}\ \overset{7}{G}\ \overset{6}{C},$$

considering the last C as a sub-dominant in this manner, C E G A; this last C would indicate the mode of G, of which C is the *sub-dominant*. See Ex. CII.

In like manner, still, if in the first series of dominants, we caused the first D to carry the third major, in this manner, D F♯ A ' c'; this D having become a tonic dominant, would signify to us the major mode of G, and the $\overset{7}{G}$ which should follow it, carrying the chord B D 'f', would relapse into the mode of C, from whence we had departed. See Ex. CIII.

Finally, in the same manner, if in this series of dominants, we should cause B to carry F♯ in this manner, B D F♯ A, this F would show that we had departed from the mode C, to enter into that of G. See Ex. CIV.

Hence it is easy to form this rule for discovering the changes of mode in the fundamental bass.

A rule for discovering the changes of mode.

1. When we find a tonic in the fundamental bass, we are in the mode of that tonic; and the mode is major or minor, according as the perfect chord is major or minor.

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2. When we find a sub-dominant, we are in the mode of the fifth above that sub-dominant; and the mode is major or minor, according as the third in the chord of the sub-dominant is major or minor.

3. When we find a tonic dominant, we are in the mode of the fifth below that tonic dominant. As the tonic dominant carries always the third major, it cannot be ascertained from this dominant alone, whether the mode be major or minor: but it is only necessary to examine the following note, which must be the tonic of the mode in which he is; by the third of this tonic it will be discovered whether the mode be major or minor.

243. Every change of the mode supposes a cadence; and when the mode changes in the fundamental bass, it is almost always either after the tonic of the mode in which we have been, or after the tonic dominant of that mode, considered then as a tonic by favour of a close which ought necessarily to be found in that place: Whence it happens that cadences in a melody for the most part presage a change of mode which ought to follow them.

244. All these rules, joined with the table of modes which we have given (art. 234.), will serve to discover in what mode we are in the middle of a piece, especially in the most essential passages, as cadences (5K).

CHAP. XIV. *Of the Chromatic and Enharmonic.*

Chromatic, what.

245. WE call that melody *chromatic* which is composed of several notes in succession, whether rising or descending by semitones. See CV. and CVI.

To an air descending by chromatic intervals, fundamental bass, what.

246. When an air is chromatic in descending, the most natural and ordinary fundamental bass is a concatenated series of tonic dominants; all of which follow one another in descending by a fifth, or, which is the same thing, in rising by a fourth. See Ex. CV. (5L).

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(5K) Two modes are so much more intimately relative, as they contain a greater number of sounds common to both; for example, the minor mode of C and the major of G, or the major mode of C and the minor of A: on the contrary, two modes are less intimately relative as the number of sounds which they contain as common to both is smaller; for instance, the major mode of C and the minor of B, &c.

When the composer, led away by the current of the modulation, that is to say, by the manner in which the fundamental bass is constituted, into a mode remote from that in which the piece was begun, he ought to continue in it but for a short time, because the ear is always impatient to return to the former mode.

(5L) We may likewise give to a chromatic melody in descending, a fundamental bass, into which may enter chords of the seventh and of the diminished seventh, which may succeed one another by the intervals of a false fifth and a fifth redundant: thus in the Example CVII. where the continued bass descends chromatically, it may easily be seen that the fundamental bass carries successively the chords of the seventh and of the seventh diminished, and that in this bass there is a false fifth from D to G♯, and a fifth redundant from G♯ to C.

The reason of this licence is, as it appears to us, because the chord of the diminished seventh may be considered as representing (art. 221.) the chord of the tonic dominant; in such a manner that this fundamental bass

$$\overset{7}{A}\ \overset{7\sharp}{D}\ \overset{7}{G\sharp}\ \overset{7}{C}\ \overset{7}{F\sharp}\ \overset{7\sharp}{B}\ E\ A$$

(see Example CVIII.) may be considered as representing (art. 116.) that which is written below,

$$\overset{7}{A}\ \overset{7}{D}\ \overset{7\sharp}{E}\ \overset{7}{C}\ \overset{7}{F\sharp}\ \overset{7\sharp}{B}\ E\ A.$$

Now this last fundamental bass is formed according to the common rules, unless that there is a broken cadence from D to $\overset{7\sharp}{E}$, and an interrupted cadence from E to C, which are licenses (art. 213. and 214.)

Fig. 1.

Tone	Tone	Semi T.	Tone	Tone	Tone	Semi T.
C	D	EF	G	A	Bc	

Fig. 9. Scale

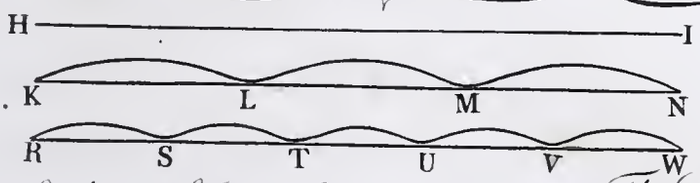
c	d	e	f	g	a	b	c
C	G	C	F	C	D	G	C

Fig. 2.

C D EF G A Bc d ef g a bc d ef g a b

Scale First — Scale Second — Scale Third

Fig. 3.



The Diatonic Scale of the Greeks

Fig. 4.

B	c	d	e	f	g	a
G	C	G	C	F	C	F

The Fundamental Bass

Fig. 5.

c	d	e	f	g	g	a	b	c
C	G	C	F	C	G	D	G	C

The Fundamental Bass

The Chromatic Species

Fig. 10. Scale

g	g♯	&c
C	E	G♯

The Fund. Bass

Fig. 11.

c	e	b♯
C	E	G♯

Fig. 6.

C, C♯, D, D♯, E, E♯, F, F♯, G, G♯, A, A♯, B, B♯, c, c♯, d, d♯, e, e♯,

Scale First — Scale Second

The first Scale of the Minor Mode

Fig. 7.

G	A	B	c	d	e	f
			Third Minor			Third Minor
E	A	E	A	D	A	D

The Fundamental Bass

Fig. 12. Scale

f	e	e	d♯
F	C	E	B

The Fund. Bass

The Second Scale of the Minor Mode

Fig. 8.

A	B	c	d	e	e	f♯	g♯	a
A	E	A	D	A	E	B	E	A

The Fundamental Bass

Fig. 13. Scale

e♭	e	e	e	e♯
C	C	A	C♯	C♯

The Fund. Bass

MUSIC.

PLATE CCCLV.

Fig. 1.

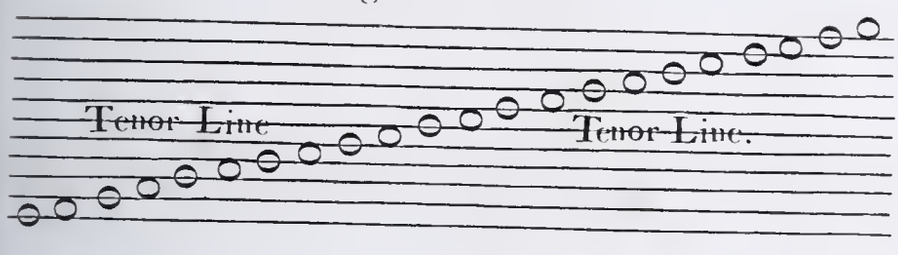


Fig. 2.

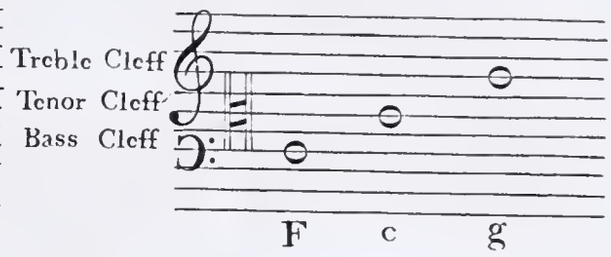


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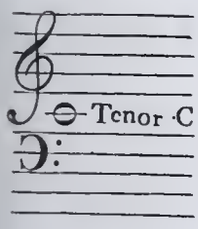


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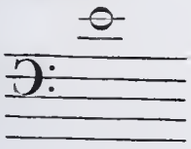


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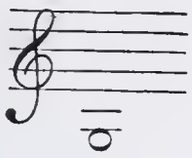


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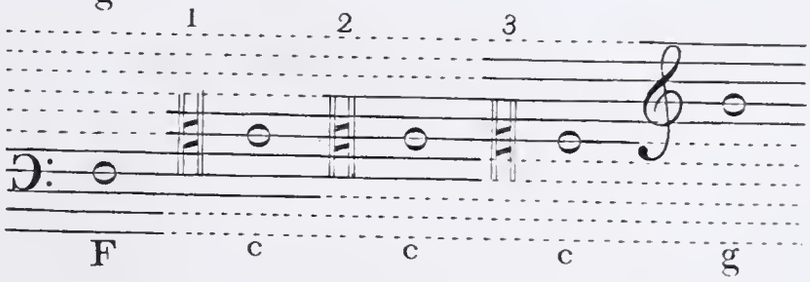


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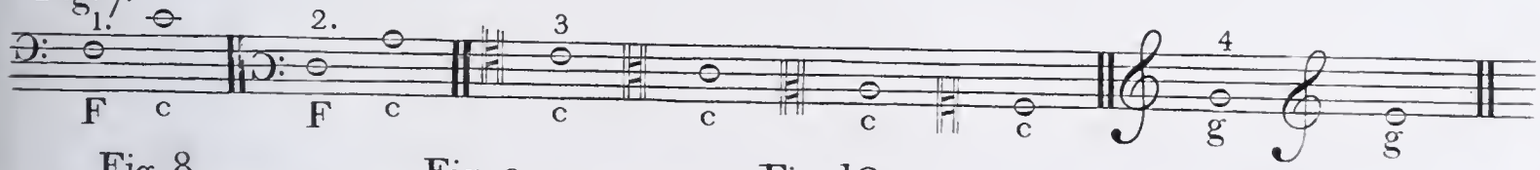


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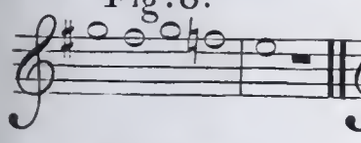


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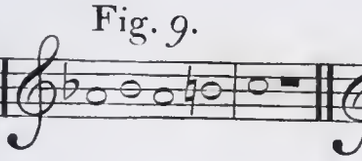


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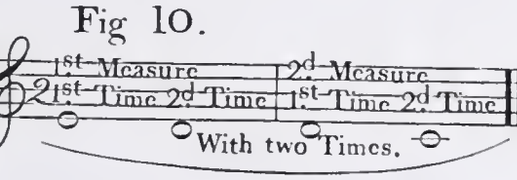


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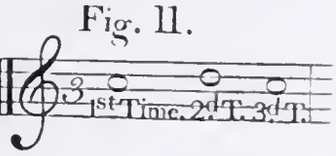


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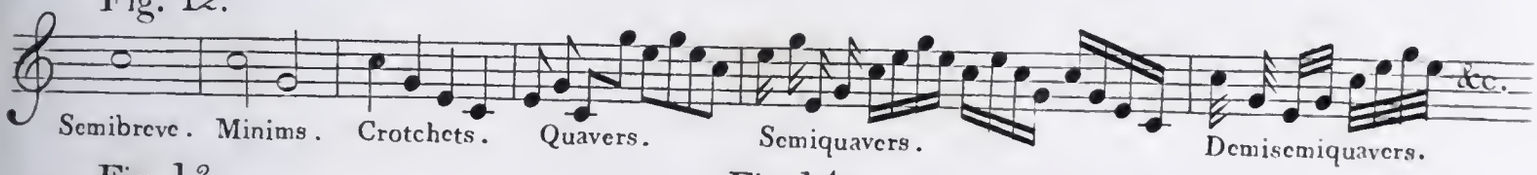


Fig. 13.

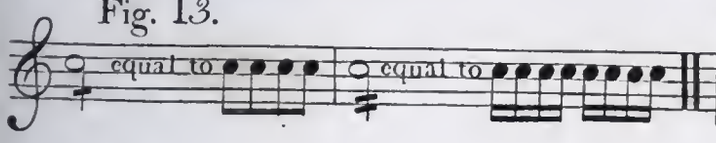


Fig. 14.



Fig. 15.

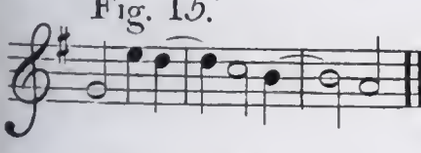


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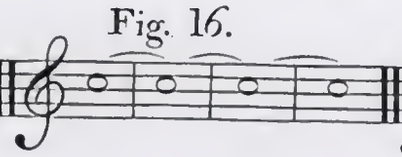


Fig. 17.

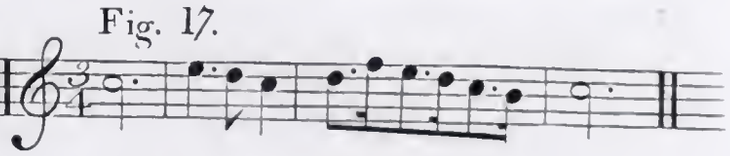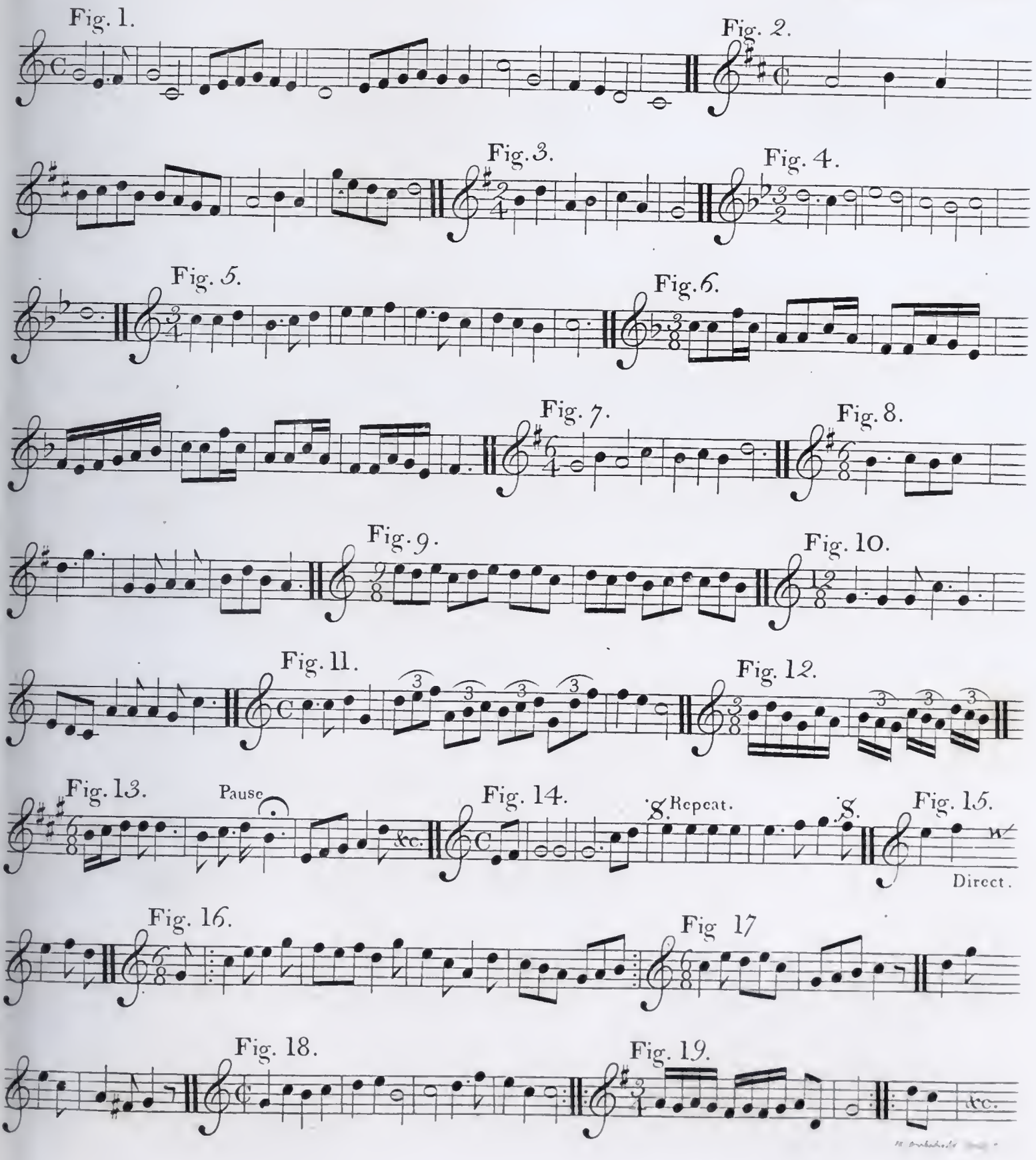


Fig. 18. Rests.

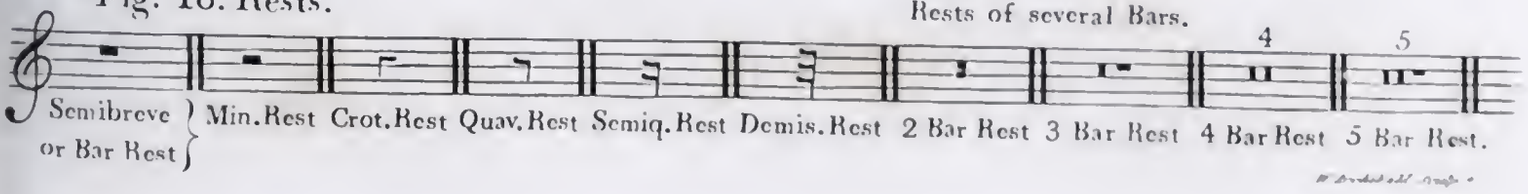
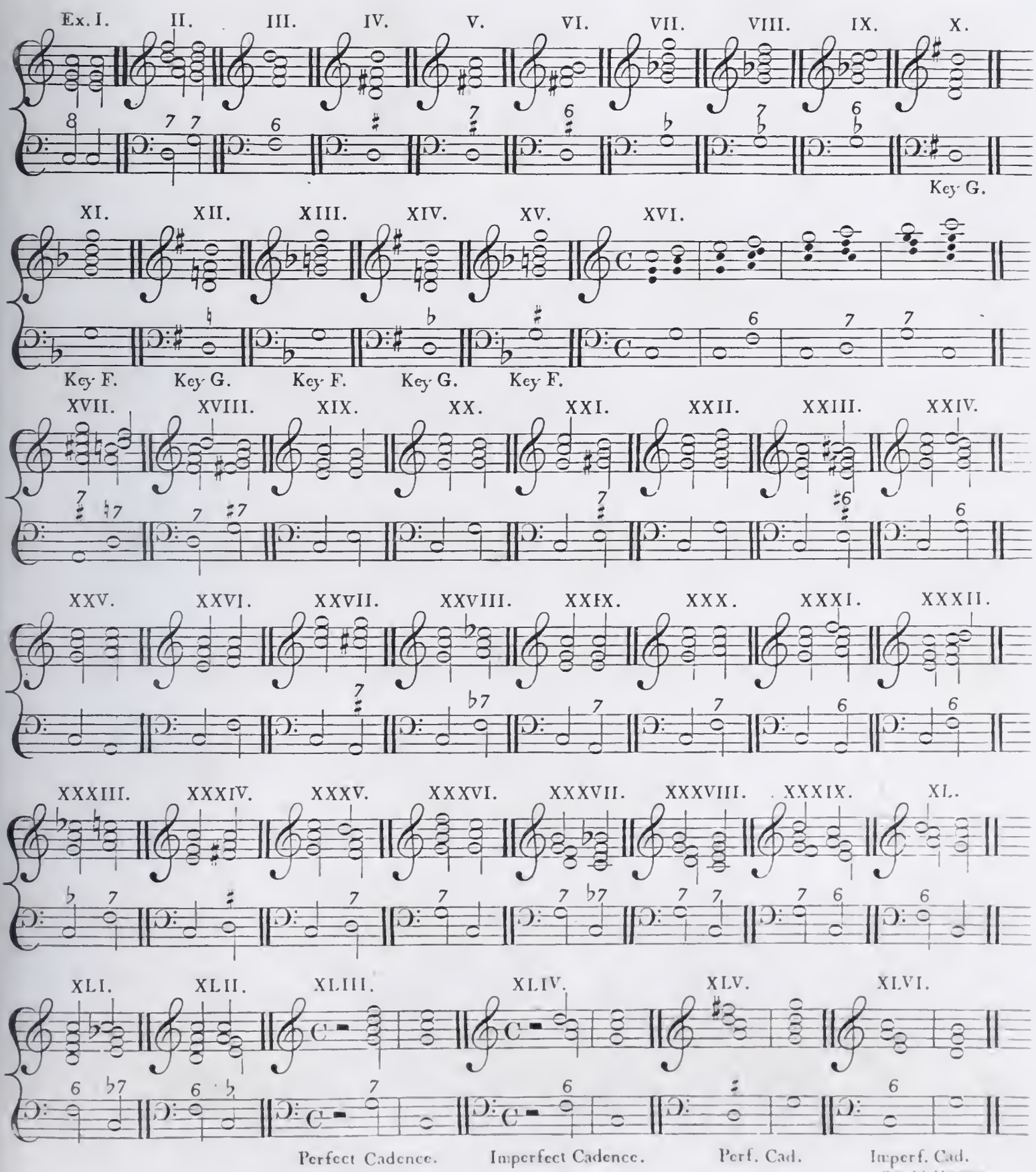
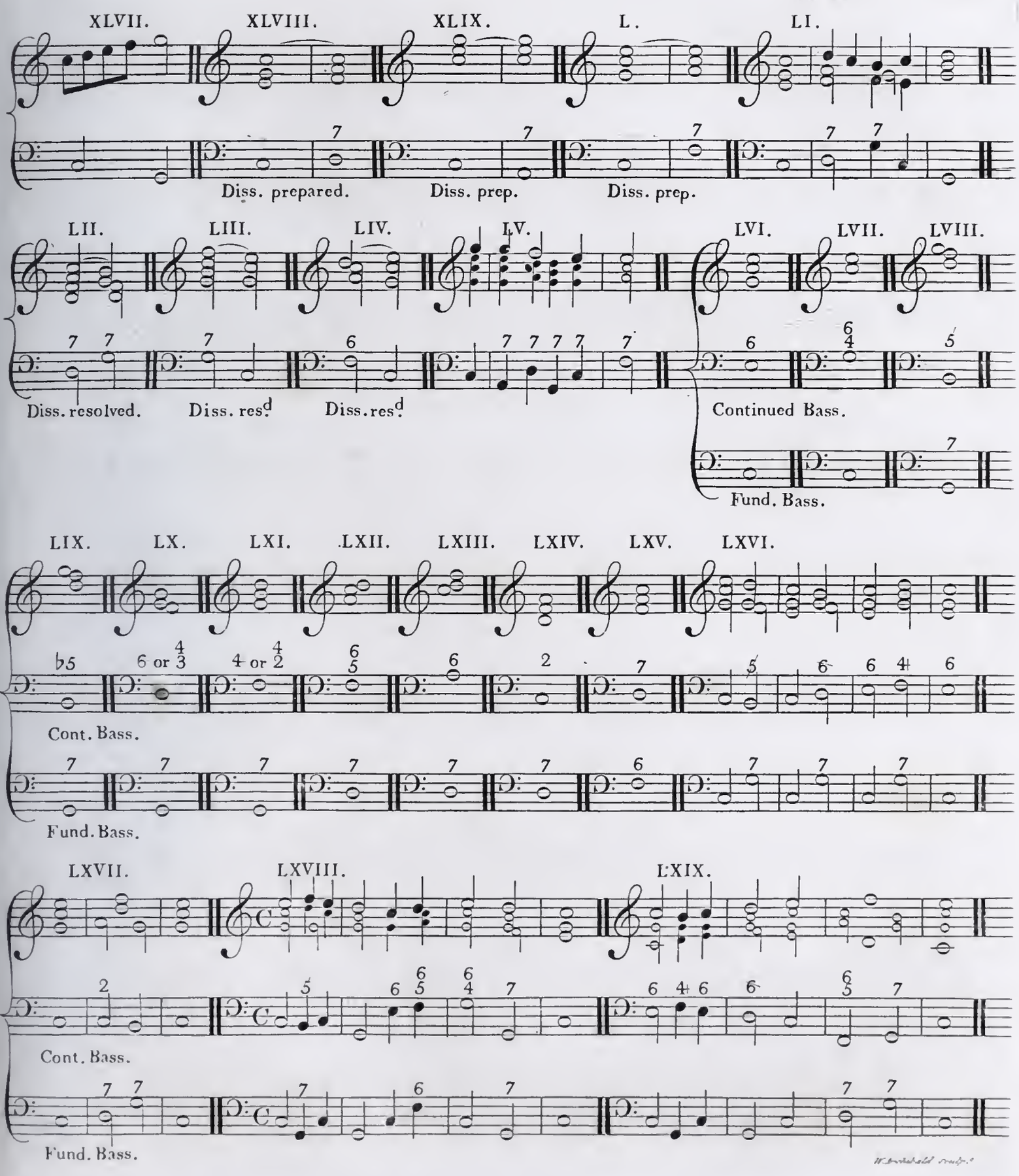
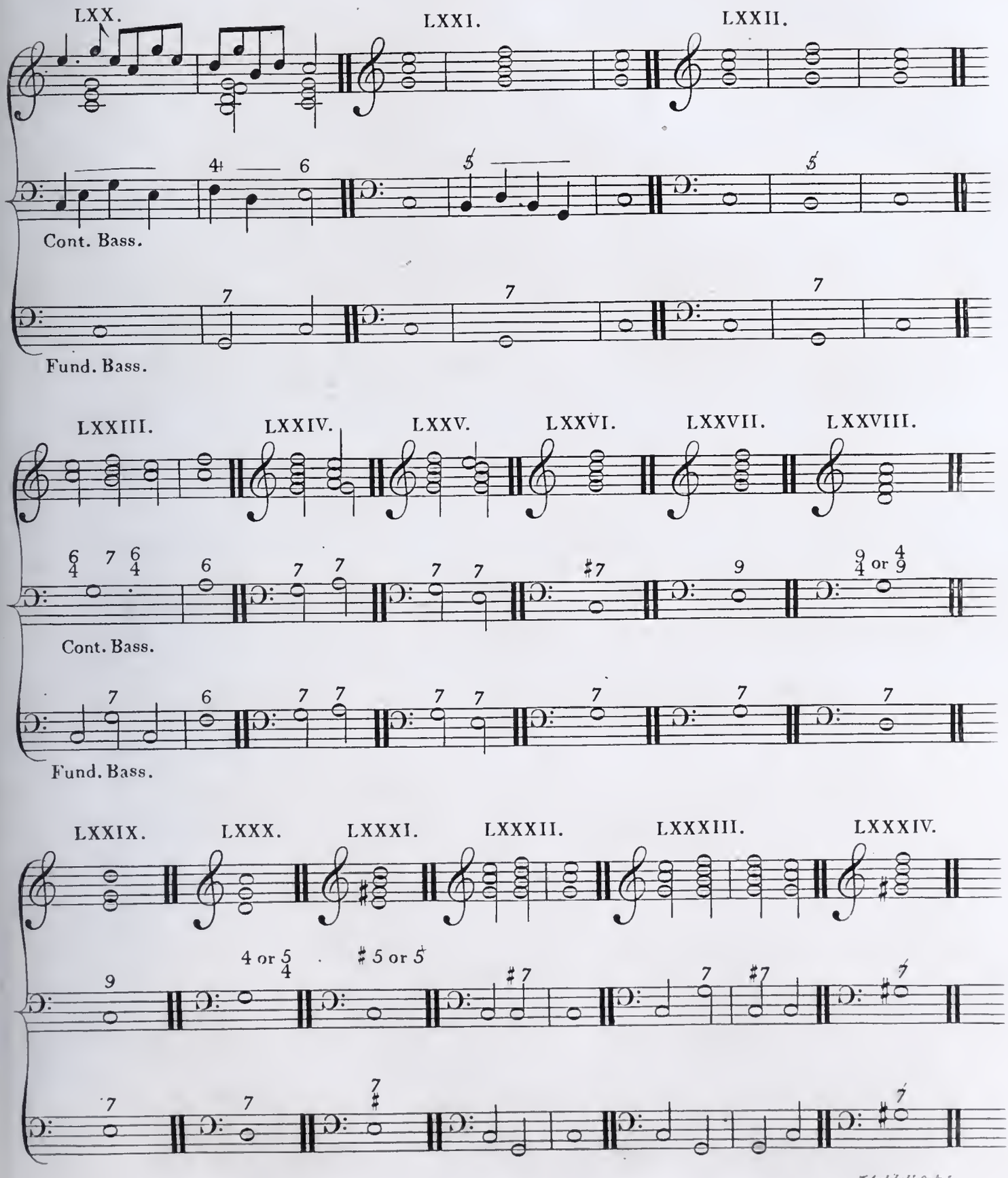
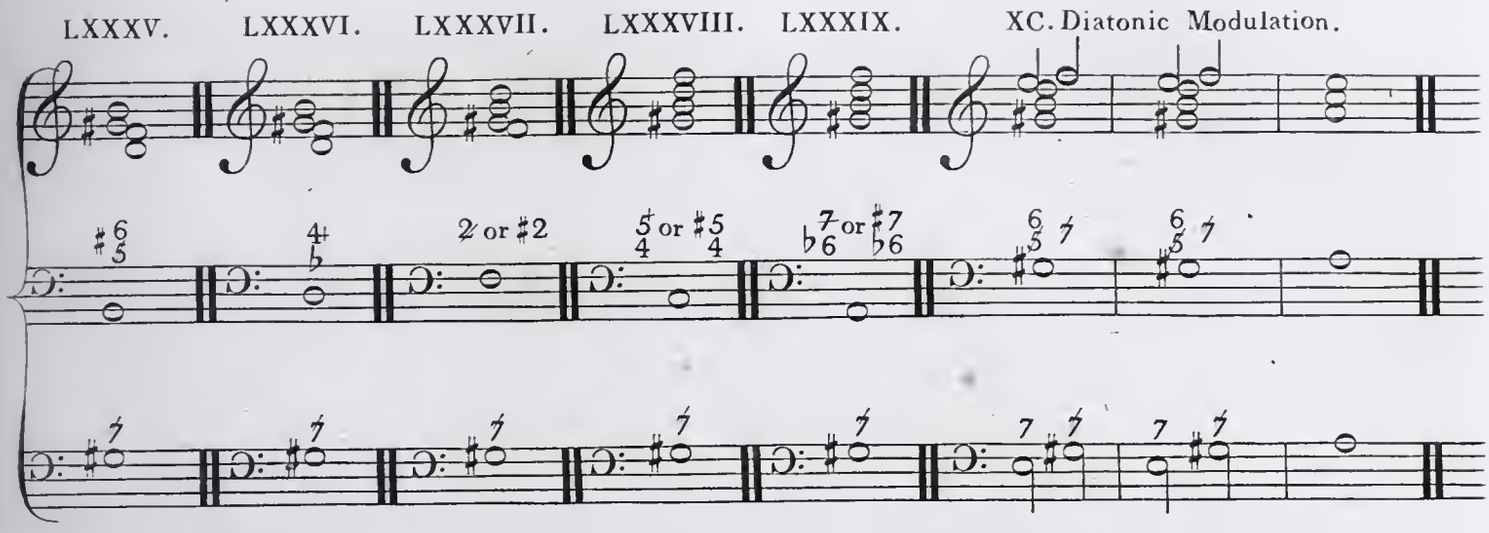


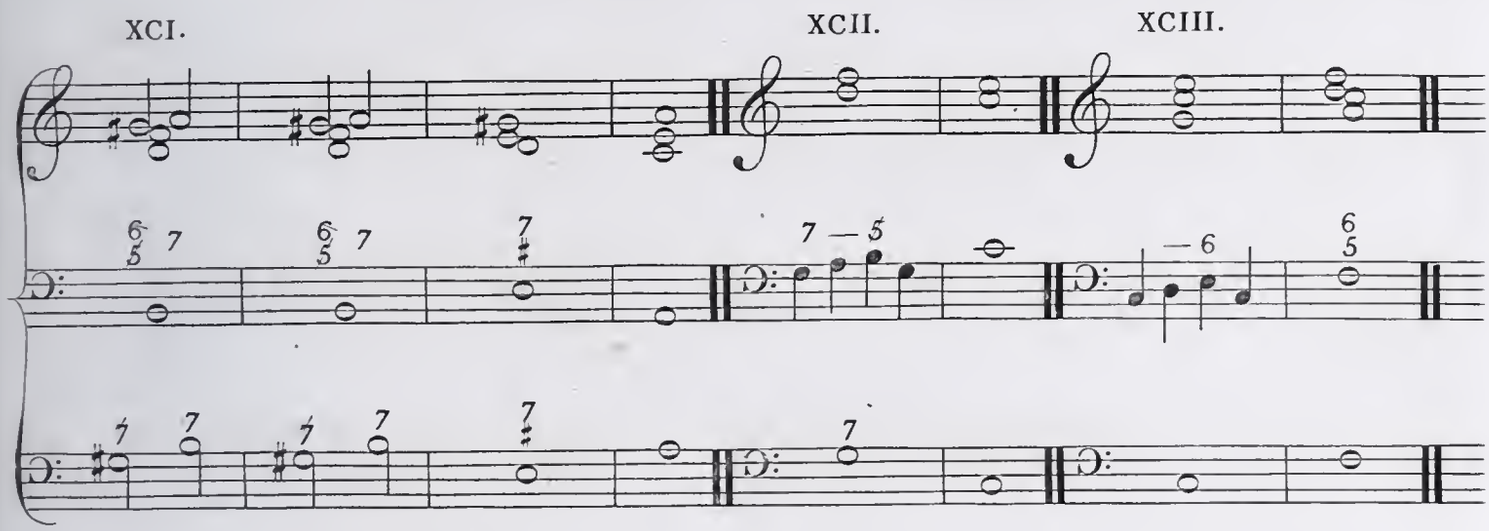

Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.
Fig. 10.
Fig. 11.
Fig. 12.
Fig. 13.
Pause
Fig. 14.
Repeat.
Fig. 15.
Direct.
Fig. 16.
Fig 17
Fig. 18.
Fig. 19.
&c.
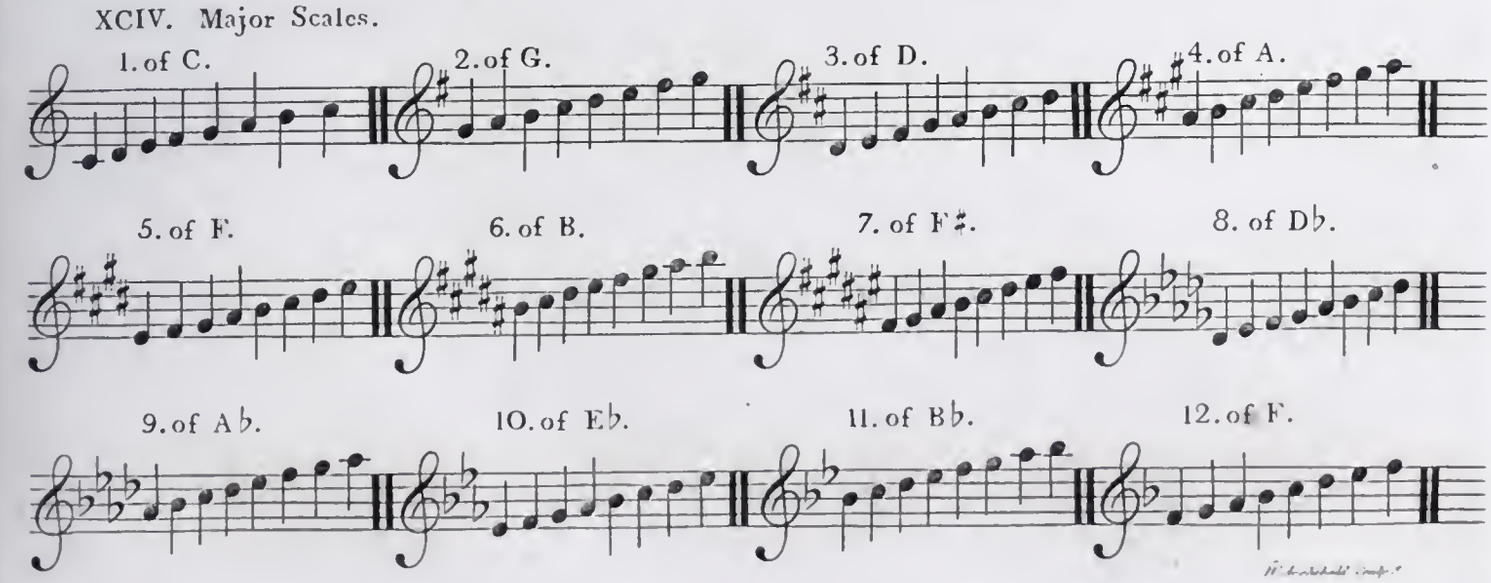

Ex. I.
II.
III.
IV.
V.
VI.
VII.
VIII.
IX.
X.
Key G.
XI.
XII.
XIII.
XIV.
XV.
XVI.
Key F.
Key G.
Key F.
Key G.
Key F.
XVII.
XVIII.
XIX.
XX.
XXI.
XXII.
XXIII.
XXIV.
XXV.
XXVI.
XXVII.
XXVIII.
XXIX.
XXX.
XXXI.
XXXII.
XXXIII.
XXXIV.
XXXV.
XXXVI.
XXXVII.
XXXVIII.
XXXIX.
XL.
XLI.
XLII.
XLIII.
XLIV.
XLV.
XLVI.
Perfect Cadence.
Imperfect Cadence.
Perf. Cad.
Imperf. Cad.

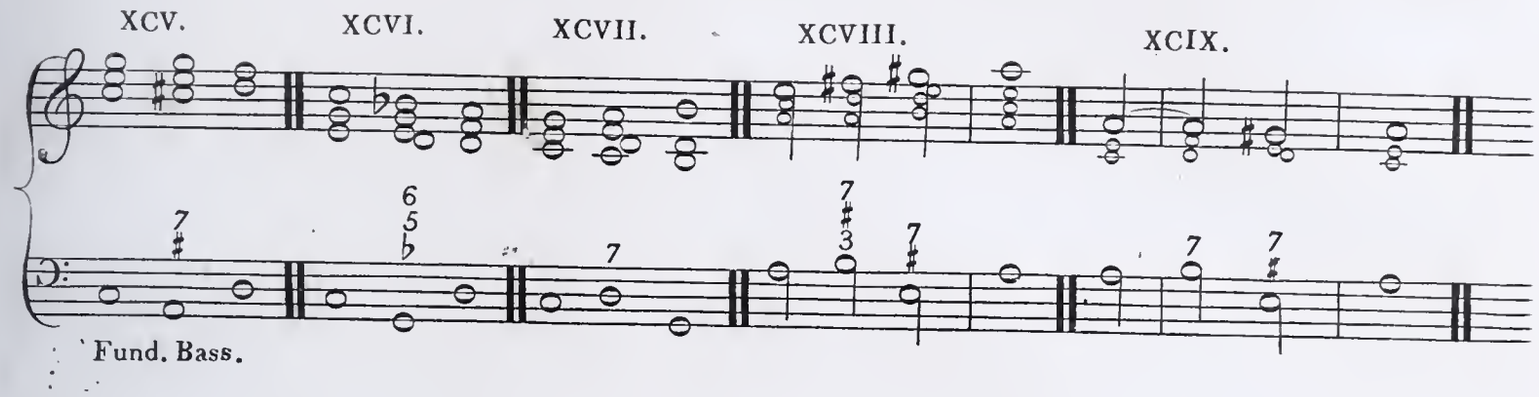

XLVII.
XLVIII.
XLIX.
L.
LI.
Diss. prepared.
Diss. prep.
Diss. prep.
LII.
LIII.
LIV.
LV.
LVI.
LVII.
LVIII.
Diss. resolved.
Diss. resd
Diss. resd
Continued Bass.
Fund. Bass.
LIX.
LX.
LXI.
LXII.
LXIII.
LXIV.
LXV.
LXVI.
Cont. Bass.
Fund. Bass.
LXVII.
LXVIII.
LXIX.
Cont. Bass.
Fund. Bass.

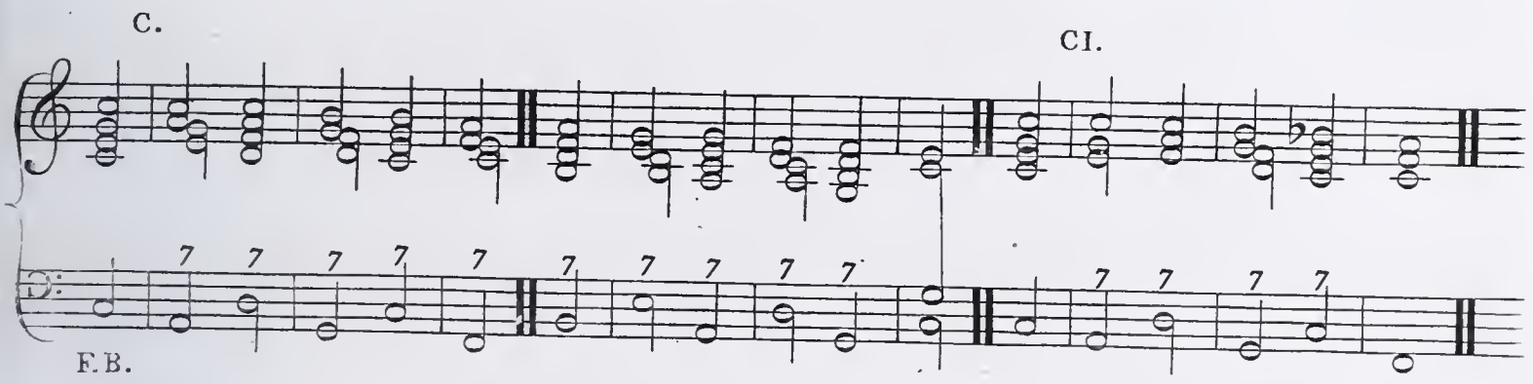

LXX.
LXXI.
LXXII.
Cont. Bass.
Fund. Bass.
LXXIII.
LXXIV.
LXXV.
LXXVI.
LXXVII.
LXXVIII.
Cont. Bass.
Fund. Bass.
LXXIX.
LXXX.
LXXXI.
LXXXII.
LXXXIII.
LXXXIV.

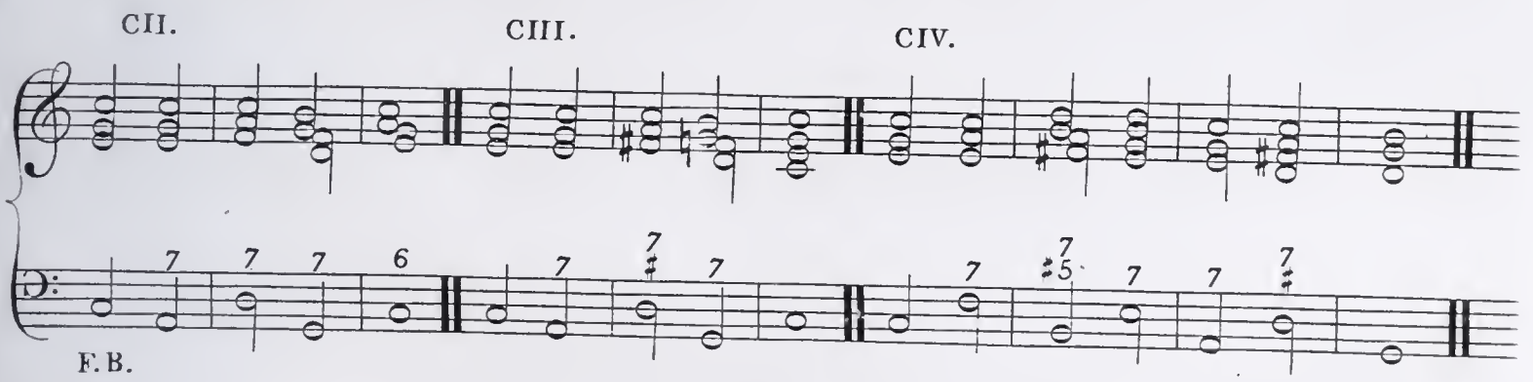

LXXXV.
LXXXVI.
LXXXVII.
LXXXVIII.
LXXXIX.
XC. Diatonic Modulation.
2 or ♯2
5/4 or ♯5/4
7 or ♯7
6/5 7
6/5 7
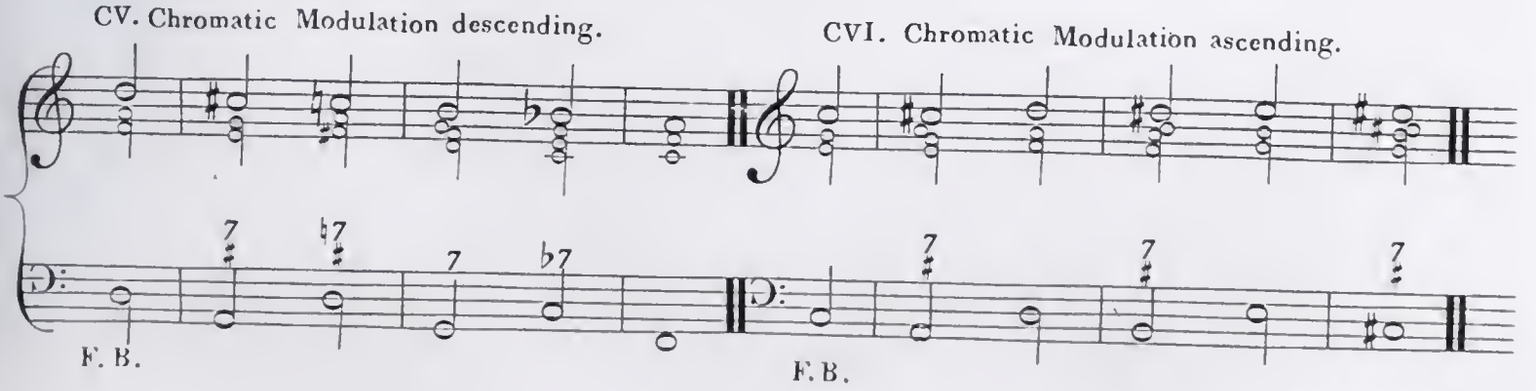

XCI.
XCII.
XCIII.
6/5 7
6/5 7
7
7 — 5
— 6
6/5


XCIV. Major Scales.
1. of C.
2. of G.
3. of D.
4. of A.
5. of F.
6. of B.
7. of F♯.
8. of D♭.
9. of A♭.
10. of E♭.
11. of B♭.
12. of F.
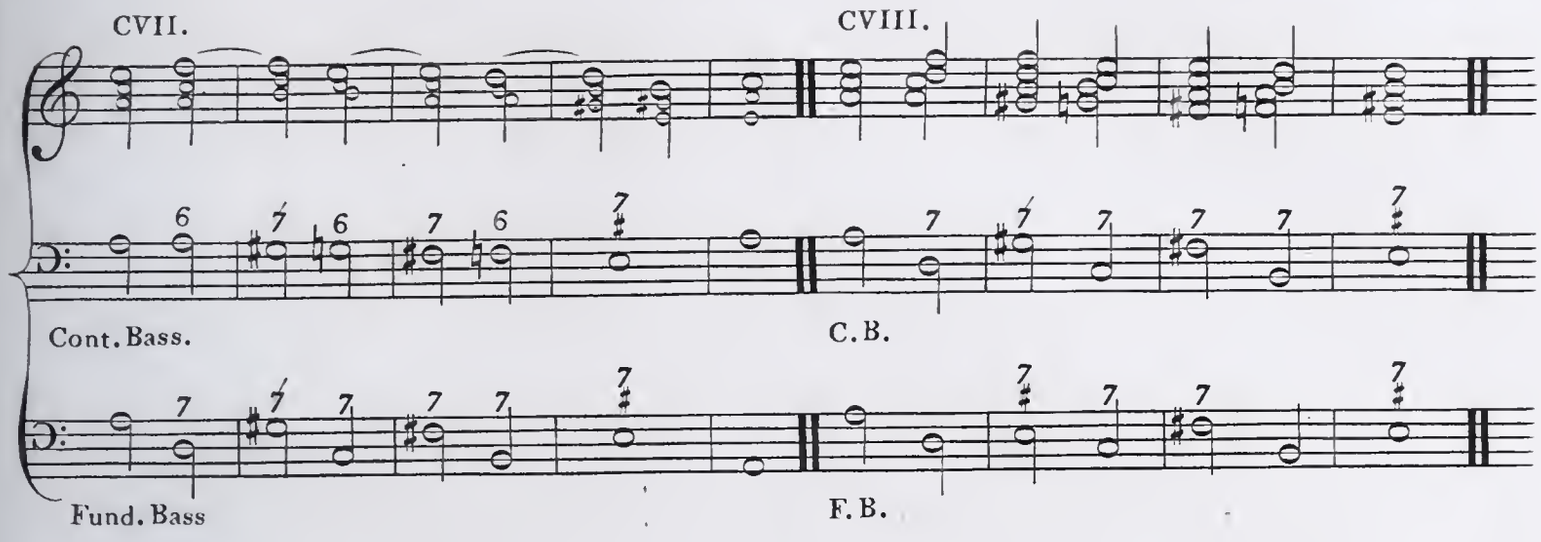








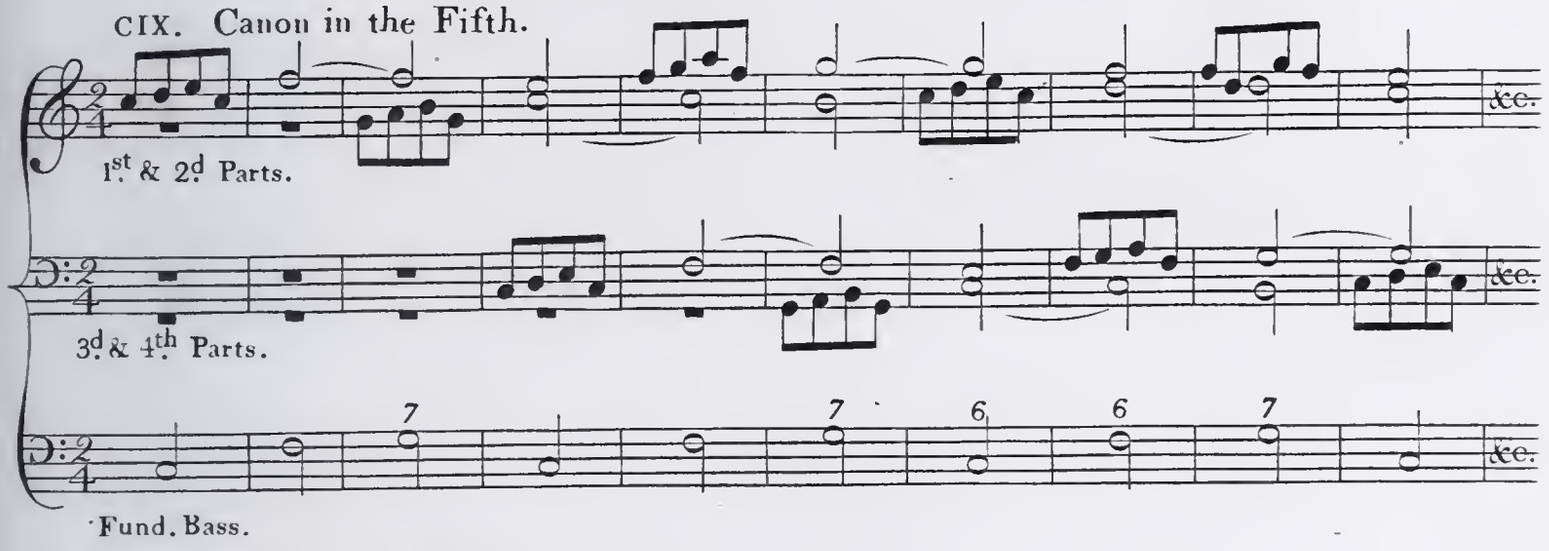
W. Archibald Sculp.

CVII.

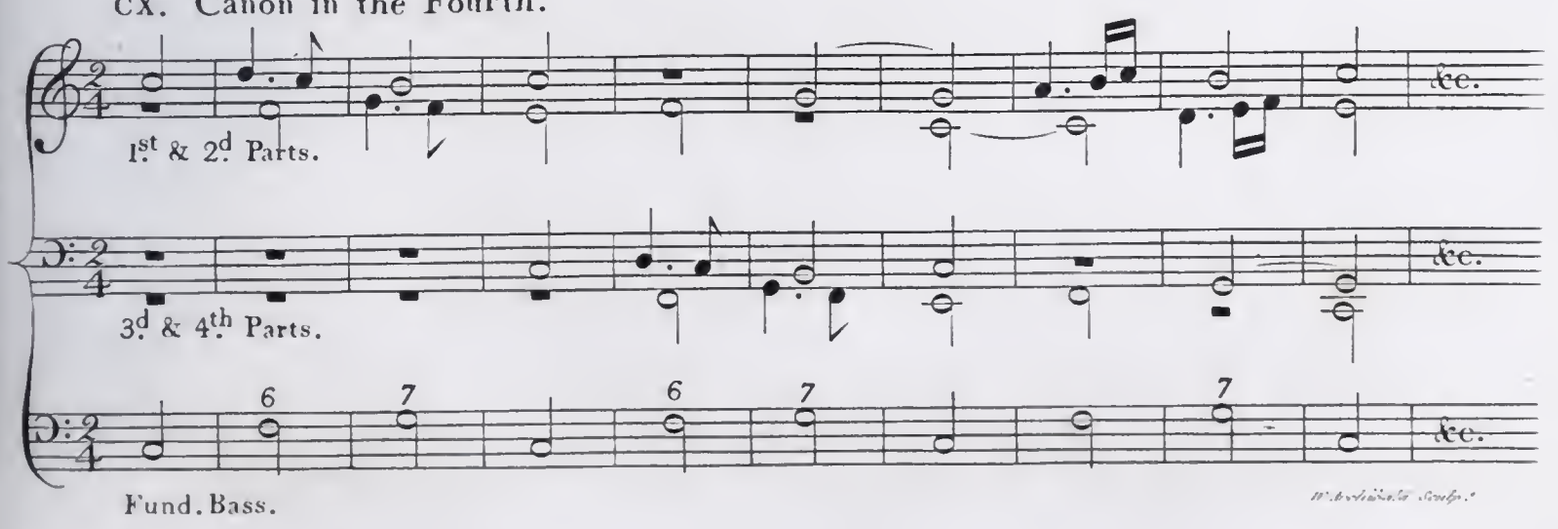
CVIII.



CIX. Canon in the Fifth.



CX. Canon in the Fourth.



Principles of Composition.

Ascending, what.

247. When the air is chromatic in ascending, one may form a fundamental bass by a series of tonics and of tonic dominants, which succeed one another alternately by the interval of a third in descending, and of a fourth in ascending, (see Ex. CVI.). There are many other ways of forming a chromatic air, whether in rising or descending; but these details in an elementary essay are by no means necessary.

Enharmonic little practised.

248. The enharmonic is very rarely put in practice; and we have explained its formation in the first book, to which we refer our readers.

See *Design*.

CHAP. XV. *Of Design, Imitation, and Fugue.*

Design, what.

249. IN music, the name of *design*, or *subject*, is generally given to a particular air or melody, which the composer intends should prevail through the piece; whether it is intended to express the meaning of words to which it may be set, or merely inspired by the impulse of taste and fancy. In this last case, design is distinguished into *imitation* and *fugue*.

See *Imitation*. Imitation, what.

250. *Imitation* consists in causing to be repeated the melody of one or several measures in one single part, or in the whole harmony, and in any of the various modes that may be chosen. When all the parts absolutely repeat the same air * or melody, and beginning one after the other, this is called a *canon* (5 M).

* See *Air, Canon, Fugue.*

Fugue consists in alternately repeating that air in treble, and in the bass, or even in all the parts, if there are more than two.

Principles of Composition.

Principal rules for composing in several parts.

251. Imitation and fugue are sometimes conducted by rules merely deducible from taste, which may be seen in the 332d and following pages of M. Rameau's *Treatise on Harmony;* where will likewise be found a detail of the rules for composition in several parts. The chief rules for composition in several parts are, that the discords should be found, as much as possible, prepared and resolved in the same part; that a discord should not be heard at the same time in several parts, because its harshness would disgust the ear; and that in no particular part there should be found two octaves or two fifths in succession (5 N) with respect to the bass. Musicians, however, do not hesitate sometimes to violate this precept, when taste or occasion require. In music, as in all the other fine arts, it is the business of the artist to assign and to observe rules; and the province of men of taste and genius to find exceptions.

APPENDIX.

THE treatise of D'Alembert is well entitled to the merit of accuracy; but perhaps a person who has not particularly studied the subject, may find difficulty in following the scientific deductions of that author.—We subjoin, therefore, a few general observations on the philosophy of musical sound, commonly called *harmonics*, which may perhaps convey the full portion of knowledge of the theory of music, with which one in

(5 M) Compositions in strict canon, where one part begins with a certain subject, and the other parts are bound to repeat the very same subject, or the reply, as it is called, in the unison, fifth, fourth, or octave, depend on the following rules, which are nothing more than a summary of the system explained by our author.

1. The chords to be employed are the tonic, and its two adjuncts; the subdominant, susceptible of an added sixth, and the dominant, susceptible of an added seventh.

2. The subject must begin in the harmony of the tonic, and as the fundamental progression from the dominant to the subdominant is not permitted (art. 33, 36.), the subdominant must follow the tonic, and the dominant the subdominant, thus,

$$C, \overset{6}{F}, \overset{7}{G}, C, \overset{6}{F}, \overset{7}{G}, C, \&c.$$

3. As the diatonic scale consists of two tetrachords, of which the first is also the second tetrachord of the mode of the sub-dominant, and the second the first tetrachord of the dominant; so, in canon, when the reply is meant to be in the mode of the dominant, the subject must be in the first tetrachord of the tonic, by which means the corresponding first tetrachord of the dominant being the second tetrachord of the tonic, the whole piece is truly in that mode. On the other hand, if the reply is to be in the mode of the sub-dominant, the subject must be in the second tetrachord of the tonic, the corresponding tetrachord of the sub-dominant being the first tetrachord of the tonic, and the mode of the tonic being thus preserved.

4. For the same reason, where the reply is in the dominant, the subject is only allowed to modulate into the mode of the sub-dominant, and the reply of course into that of the tonic. And where the reply is in the dominant, the subject is to modulate only into the mode of the sub-dominant, the reply following of course into that of the tonic. Were the contrary modulation permitted, the reply would depart too far from the mode of the tonic.

Lastly, When the reply is to be in the mode of the dominant, it must commence in the measure bearing that harmony; and in the same way, the reply in the sub-dominant must begin in the measure which bears the harmony of the sub-dominant.

If these rules be observed, and due attention paid to the preparation and resolution of dissonances, composition in strict canon, in any number of parts, will be found to be by no means difficult. See Ex. CIX. and CX.

(5 N) Yet there may be two fifths in succession, provided the parts move in contrary directions, or, in other words, if the progress of one part be ascending, and the other descending; but in this case they are not properly two fifths, they are a fifth and a twelfth: for example, if one of the parts in descending should sound F D, and the other 'e a' in rising, C is the fifth of F, and 'a' the twelfth of D.

General Observations on Harmonics.

search only of general information, and not a professed student of this particular science, would choose to rest satisfied.

The theory of musical sound, which only in the beginning of the present century was ultimately established by mathematical demonstration, is no other than that which distinguished the ancient musical sect who followed the opinions of Pythagoras on that subject.

No part of natural philosophy has been more fruitful of hypothesis than that of which musical sound is the object. The musical speculators of Greece arranged themselves into a great number of sects, the chief of whom were the Pythagoreans and the Aristoxenians.

Pythagoras supposed the air to be the *vehicle* of sound; and the agitation of that element, occasioned by a similar agitation in the parts of the sounding body, to be the *cause* of it. The vibrations of a string or other sonorous body, being communicated to the air, affected the auditory nerves with the sensation of sound; and this sound, he argued, was acute or grave in proportion as the vibrations were quick or slow.—He discovered by experiment, that of two strings equal in every thing but length, the shorter made the quicker vibrations, and emitted the acuter sound: in other words, that the number of vibrations made in the same time by two strings of different lengths, was inversely as those lengths; that is, the greater the length the smaller the number of vibrations in any given time. Thus sound, considered in the vibrations that cause it, and the dimensions of the vibrating body, came to be reduced to quantity, and as such was the subject of calculation, and expressible by numbers.—For instance, the two sounds that form an octave could be expressed by the numbers 1 and 2, which would represent either the number of vibrations in a given time, or the length of the strings; and would mean that the acuter sound vibrates twice, while the graver vibrates once; or that the string producing the lower sound is twice the length of that which gives the higher. If the vibrations were considered, the higher sound was as 2, the lower as 1; the reverse, if the length was alluded to. In the same manner, in the same sense, the 5th would be expressed by the ratio of 2 to 3, and the 4th by that of 3 to 4.

Aristoxenes, in opposition to the calculations of Pythagoras, held the ear to be the sole standard of musical proportions. That sense he accounted sufficiently accurate for musical, though not for mathematical purposes; and it was in his opinion absurd to aim at an artificial accuracy in gratifying the ear beyond its own power of distinction. He, therefore, rejected the velocities, vibrations, and proportions of Pythagoras, as foreign to the subject, in so far as they substituted *abstract causes* in the room of *experience*, and made music the object of *intellect* rather than of *sense*.

General Observations on Harmonics.

Of late, however, as has been already mentioned, the opinions of Pythagoras have been confirmed by absolute demonstration; and the following propositions, in relation to musical sound, have passed from conjecture to certainty.

Sound is generated by the vibrations of elastic bodies, which communicate the like vibrations to the air, and these again the like to our organs of hearing. This is evident, because sounding bodies communicate tremors to other bodies at a distance from them. The vibrating motion, for instance, of a musical string, excites motion in others, whose tension and quantity of matter dispose their vibrations to keep time with the undulations of air propagated from it (the string first set in motion).

If the vibrations be isochronous, and the sound musical, continuing at the same pitch, it is said to be acuter, sharper, or higher, than any other sound whose vibrations are slower; and graver, flatter, or lower, than any other whose vibrations are quicker.—For while a musical string vibrates, its vibrations become quicker by increasing its tension or diminishing its length; its sound at the same time will be more acute: and, on the contrary, by diminishing its tension or increasing its length, the vibrations will become slower and the sound graver. The like alteration of the pitch of the sound will follow, by applying, by means of a weight, an equal degree of tension to a thicker or heavier and to a smaller or lighter string, both of the same length, as in the smaller string the mass of matter to be moved by the same force is less.

If several strings, however, different in length, density, and tension, vibrate altogether in equal times, their sounds will have all one and the same pitch, however they may differ in loudness or other qualities.—They are called *unisons*. The vibrations of unisons are isochronous.

The vibrations of a musical string, whether wider or narrower, are nearly isochronous. Otherwise, while the vibrations decrease in breadth till they cease, the pitch of the sound could not continue the same (which we perceive by experience it does), unless where the first vibrations are made very violently; in which case, the sound is a little acuter at the beginning than afterwards.

Lastly, The word *vibration* is understood to mean the time which passes between the departure of the vibrating body from any assigned place and its return to the same.

MUS

MUS

Music, Musimon.

Glass-Music. See HARMONICA.

MUSIMON, in *Natural History*, the name of an animal esteemed a species of sheep, described by the ancients as common in Corsica, Sardinia, Barbary, and the north-east parts of Asia. It has been doubted whether the animal described under this name is now any where to be found in the world; and whether it was not probably a spurious breed between two animals of different species, perhaps the sheep and goat, which, like the mule, not being able to propagate its species, the production of them may have been discontinued.

Musimon.

Buffon supposes it to be the sheep in a wild state; and it is described as such by Mr Pennant. These animals live in the mountains, and run with great swiftness among the rocks. Those of Kamtschatka are so strong, that 10 men can scarce hold one; and the horns are so large as sometimes to weigh 30 pounds, and

Musimon || Mussulman.

and so capacious that young foxes often shelter themselves in the hollow of such as by accident fall off in the deserts.

MUSIVUM AURUM. See CHEMISTRY, N° 1806.

MUSK, a very strong scented substance, found in a bag under the belly of a species of moschus. See MOSCHUS, MAMMALIA *Index*. And for an account of the nature and properties of musk, see MATERIA MEDICA *Index*.

Musk Animal. See MOSCHUS,
Musk Ox. See BOS,
Musk Rat. See CASTOR,
} MAMMALIA *Index*.

MUSKET, or MUSQUET, properly a fire-arm borne on the shoulder, and used in war; to be fired by the application of a lighted match.

The length of the barrel is fixed to three feet eight inches from the muzzle to the touch-pan, and its bore is to be such as may receive a bullet of 14 in a pound, and its diameter differs not above one 50th part from that of the bullet.

Muskets were anciently borne in the field by the infantry, and were used in England so lately as the beginning of the civil wars. At present they are little used, except in the defence of places; fusees or firelocks having taken their place and name.

MUSKETOON, a kind of short thick musket, whose bore is the 38th part of its length; it carries five ounces of iron, or seven and a half of lead, with an equal quantity of powder. This is the shortest kind of blunderbusses.

MUSLIN, a fine sort of cotton cloth, which bears a downy knot on its surface. There are several sorts of muslins brought from the East Indies, and more particularly from Bengal; such as dorcas, betelles, mulmuls, tanjebs, &c. Muslin is now manufactured in Britain, and brought to very great perfection.

MUSQUETOE. See CULEX, ENTOMOLOGY *Index*.

MUSSULMAN, or MUSYLMAN, a title by which the Mahometans distinguish themselves; signifying, in the Turkish language, "true believer, or orthodox." See MAHOMETANISM.

In Arabic, the word is written *Moslem*, *Mosleman*, or *Mosolman*. The appellation was first given to the Saracens, as is observed by Leunclavius.—There are two kinds of Mussulmans, very averse to each other; the one called *Sonnites*, and the other *Shiites*.—The Sonnites follow the interpretation of the Alcoran given by Omar; the Shiites are the followers of Ali. The subjects of the king of Persia are Shiites; and those of the grand signior, Sonnites. See SONNA, and ALCORAN.

According to some authors the word Mussulman signifies *saved*, that is, predestinated: and hence the Mahometans give themselves the appellation, as believing they are all predestinated to salvation.—Martinius is more particular as to the origin of the name; which he derives from the Arabic מסלם *musalem*, "saved, snatched out of danger:" the Mahometans, he observes, establishing their religion by fire and sword, massacred all those who would not embrace it, and granted life to all that did, calling them *Mussulmans*, q. d. *erepti è periculo*; whence the word, in course of time, became the distinguishing title of all those of that sect, who have affixed to it the signification of *true believers*.

MUST, MUSTUM, sweet wine newly pressed from the grape; or the new liquor pressed from the fruit before it is fermented. See WINE.

Mussulman || Mutilation.

MUSTARD. See SINAPI, BOTANY *Index*.

MUSTARD Seed. For an account of its medical qualities, see MATERIA MEDICA *Index*.

MUSTELA, the OTTER and WEASEL; a genus of quadrupeds of the order of feræ. See MAMMALIA *Index*.

MUSTER, in a military sense, a review of troops under arms, to see if they be complete and in good order; to take an account of their numbers, the condition they are in, viewing their arms and accoutrements, &c.

MUSTER-Master-general, or *Commissary-general of the MUSTERS*; one who takes account of every regiment, their number, horses, arms, &c. reviews them, sees the horses be well mounted, and all the men well armed and accoutred, &c.

MUSTER-Rolls, lists of soldiers in each company, troop, or regiment, by which they are paid, and the strength of the army is known.

MUTABILITY is opposed to immutability. See IMMUTABILITY.

MUTATION, the act of changing, or sometimes the change itself.

MUTATION, in the ancient music, is applied to the changes or alterations that happen in the order of the sounds which compose the melody.

MUTATIONES, among the Romans, post stages or places where the public couriers were supplied with fresh horses.—The *mutationes* were wholly designed for the use of these couriers, or messengers of state; in which respect they differ from *mansiones*.

MUTCHKIN, a liquid measure used in Scotland; it contains four gills, and is the fourth part of a Scotch pint.

MUTE, in a general sense, signifies a person that cannot speak, or has not the use of speech.

MUTE, in *Law*, a person that stands dumb or speechless when he ought to answer, or to plead. See ARRAIGNMENT.

MUTE, in *Grammar*, a letter which yields no sound without the addition of a vowel. The simple consonants are distinguished into mutes and liquids, or semivowels. See the articles CONSONANT, LIQUID, &c.

The mutes in the Greek alphabet are nine, three of which, viz. π, κ, τ, are termed *tenues*; three β, γ, δ, termed *mediæ*; and three ϕ, χ, θ, termed *aspiratæ*. See the article ASPIRATE, &c.

The mutes of the Latin alphabet are also nine, viz. B, C, D, G, I, K, P, Q, T,

MUTILATION, the retrenching or cutting away any member of the body.

This word is also extended to statues and buildings, where any part is wanting, or the projecture of any member, as a cornice or an impost, is broken off. It is sometimes also used in a more immediate manner for castration: (See CASTRATION and EUNUCH). The practice of this sort of mutilation is of various kinds: the Hottentots are said to cut away one testicle from their children upon supposition that they are thereby made lighter and more active for running. In other countries, poor people completely mutilate their boys,

Mutilation || Mutina.

to prevent the misery and want which would attend their offspring. Those who have nothing in view but the improvement of a vain talent, or the formation of a voice which disfigures nature, as was the case formerly in Italy, are contented with cutting away the testicles. But in some countries of Asia, especially among the Turks, and in a part of Africa, those whom jealousy inspires with distrust would not think their wives safe in the custody of such eunuchs: They employ no slaves in their seraglios who have not been deprived of all the external parts of generation.

Amputation is not the only means of accomplishing this end. Formerly, the growth of the testicles was prevented, and their organization destroyed by simple rubbing, while the child was put into a warm bath made of a decoction of plants. Some pretend that by this species of castration the life is in no danger. Amputation of the testicles is not attended with much danger; but complete amputation of the external parts of generation is often fatal. This operation can only be performed on children from seven to ten years of age. Eunuchs of this kind, owing to the danger attending the operation, cost in Turkey five or six times more than others. *Chardin* relates, that this operation is so painful and dangerous after 15 years of age, that hardly a fourth part of those by whom it is undergone escape with life. *Pietro della Valle*, on the contrary, informs us, that in Persia those who suffer this cruel and dangerous operation as a punishment for rapes and other crimes of this kind, are easily cured though far advanced in life; and that nothing but ashes is applied to the wound.

There are eunuchs at Constantinople, throughout all Turkey, and in Persia, of a gray complexion: they come for the most part from the kingdom of Golconda, the peninsula on this side the Ganges, the kingdoms of Assan, Aracan, Pegu, and Malabar. Those from the gulf of Bengal are of an olive colour. There are some white eunuchs who come from Georgia and Circassia, but their number is small. The black eunuchs come from Africa, and especially from Ethiopia. These, in proportion to their horrible appearance, are the more esteemed and cost dearer. It appears that a very considerable trade is carried on in this species of men; for Tavernier informs us, that when he was in the kingdom of Golconda, in the year 1657, 22,000 eunuchs were made it it. In that country they are sold at the fairs.

The object of improving the voice by means of this species of mutilation, it is said, often fails; for of 2000 victims to the luxury and extravagant caprices of the art, hardly three are found who unite good talents with good organs. The other languishing and inactive wretches are, in some measure, outcasts from both sexes, and paralytic members in the community. But let us pay the tribute which is due to that virtuous pontiff Pope Clement VIII. who, listening to the voice of modesty and humanity, proscribed and abolished this detestable and infamous practice. Mutilation, he declared was the most abominable and disgraceful of crimes.

MUTILLA, a genus of insects belonging to the order of hymenoptera. See ENTOMOLOGY *Index*.

MUTINA, in *Ancient Geography*, a noble city of the Cispadana, made a Roman colony in the same year with Parma, situated between the rivers Gabellus and Scultenna, on the Via Æmilia. Here D. Brutus being besieged by Antony, was relieved by the consuls Hirtius and Pansa. The Greeks called it *Mutine;* except Polybius, in whom it is *Motine;* and in Ptolemy *Mutina*, after the Roman manner.—Now *Modena*, a city of Lombardy, and capital of a cognominal duchy. E. Long. 11. 20. N. Lat. 44 45.

Mutina || Mutius.

MUTINY, in a military sense, to rise against authority.—"Any officer or soldier who shall presume to use traiterous or disrespectful words against the sacred person of his majesty, or of the royal family, is guilty of mutiny.

"Any officer or soldier who shall behave himself with contempt or disrespect towards the general or other commander in chief of our forces, or shall speak words tending to their hurt or dishonour, is guilty of mutiny.

"Any officer or soldier who shall begin, excite, cause, or join in, any mutiny or sedition, in the troop, company, or regiment, to which he belongs, or in any other troop or company in our service, or in any party, post, detachment, or guard, on any pretence whatsoever, is guilty of mutiny.

"Any officer or soldier who, being present at any mutiny or sedition, does not use his utmost endeavours to suppress the same, or coming to the knowledge of any mutiny, or intended mutiny, does not without delay give information to his commanding officer, is guilty of mutiny.

"Any officer or soldier, who shall strike his superior officer, or draw, or offer to draw, or shall lift up any weapon, or offer any violence against him, being in the execution of his office, on any pretence whatsoever, or shall disobey any lawful command of his superior officer, is guilty of mutiny."

Mutiny Act. See *Military State*.

MUTIUS, Caius, surnamed *Cordus*, and afterwards *Scævola*, was one of the illustrious Roman family of the Mutii, and rendered his name famous in the war between Porsenna king of Tuscany and the Romans. That prince resolving to restore the family of Tarquin the Proud, went to besiege Rome 507 B. C. Mutius resolved to sacrifice himself for the saftey of his country; and boldly entering the enemy's camp, killed Porsenna's secretary, whom he took for Porsenna himself. Being seized and brought before Porsenna, he told him boldly, that 300 young men like himself had sworn to murder him; *but since this hand has missed thee*, continued he, *it must be punished;* then putting his right hand on the burning coals, he let it burn with such constancy as astonished the beholders. The king, amazed at the intrepidity of this young Roman, ordered that he should have his freedom and return to Rome, and soon after concluded a peace with the Romans. From this action Mutius obtained the surname of *Scævola*, "or left-handed," which was enjoyed by his family.

Mutius Scævola, Q. surnamed the *Augur*, was an excellent civilian, and instructed Cicero in the laws. He was made prætor in Asia; was afterwards consul, and performed very important services for the republic.

He ought not to be confounded with *Quintus Mutius Scævola*, another excellent civilian, who was prætor

Mutius || Mycenæ.

tor in Asia, tribune of the people, and at length consul, 95 B. C. He governed Asia with such prudence and equity, that his example was proposed to the governors who were sent into the provinces. Cicero says, "that he was the most eloquent orator of all the civilians, and the most able civilian of all the orators." He was assassinated in the temple of Vesta, during the wars of Marius and Sylla, 82 B. C.

MUTTON, the common name of the flesh of a sheep after the animal has been killed. Mutton has been commonly preferred to all the fleshes of quadrupeds. And indeed, besides its being more perfect, it has the advantage over them of being more generally suited to different climates: whereas beef, *e. g.* requires a very nice intermediate state, which it seems to enjoy chiefly in England; for although Scotland supplies what are reckoned the best cattle, it is in the rich English pastures that they are brought to perfection. Now the sheep can be brought almost to the same perfection in this bleak northern region as in the southern countries.

MUTUAL, a relative term, denoting something that is reciprocal between two or more persons.

Thus we say, *mutual assistance*, *mutual aversion*, &c. There are mutual or reciprocal duties, offices, &c. between superiors and inferiors; as the king and his subjects, the master and his servants, &c.

Vaugelas makes a distinction between *mutual* and *reciprocal*: *mutual*, according to him, is understood of what is between two only; and *reciprocal*, of what is between more than two: but this distinction is little regarded in common use.

MUTULE, in *Architecture*, a kind of square modillion set under the cornice of the Doric order.

MUTUNUS, or MUTINUS, in *Fabulous History*, a deity among the Romans, similar to the Priapus of the Greeks.

MUZZLE *of a* GUN *or* MORTAR, the extremity at which the powder and ball is put in; and hence the muzzle ring is the metalline circle or moulding that surrounds the mouth of the piece.

MYA, the GAPER; a genus of shell fish. See CONCHOLOGY *Index*.

MYAGRUM, GOLD OF PLEASURE, a genus of plants, belonging to the tetradynamia class; and in the natural method ranking under the 39th order, *Siliquosæ*. See BOTANY *Index*.

MYCALE, a city and mountain of Caria; also a promontory of Asia opposite Samos, celebrated for a battle which was fought there between the Greeks and Persians about the year of Rome 275. The Persians were about 100,000 men, who had just returned from the unsuccessful expedition of Xerxes in Greece.—They had drawn their ships to the shore, and fortified themselves strongly, as if determined to support a siege. They suffered the Greeks to disembark from their fleet without the least molestation, and were soon obliged to give way before the cool and resolute intrepidity of an inferior number of men. The Greeks obtained complete victory, slaughtered some thousands of the enemy, burned their camp, and sailed back to Samos with an immense booty, in which were 70 chests of money.

MYCENÆ, in *Ancient Geography*, a town of Argolis, in Peloponnesus. The kingdom of the Argives was divided into two portions by Acrisius and his brother Prœtus. Argos and Mycenæ were their capitals. —These, as belonging to the same family, and distant only about 50 stadia or six miles and a quarter from each other, had one tutelary deity, Juno, and were jointly proprietors of her temple, the Heræum, which was near Mycenæ. It was here that Agamemnon reigned. He enlarged his dominions by his valour and good fortune, and possessed, besides Mycenæ, the region about Corinth and Sicyon, and that called afterwards Achæa. On his return from Troy, he was slain with his companions at a banquet. Mycenæ then declined: and under the Heraclidæ was made subject to Argos. (See ARGOS and ARGEIA.) The Mycenæans sending 80 men, partook with the Lacedæmonians in the glory acquired at Thermopylæ. The jealousy of the Argives produced the destruction of their city, which was abandoned after a siege, and laid waste in the first year of the 78th Olympiad, or 466 years before Christ. Some part of the wall remained in the second century, with a gate on which were lions, a fountain, the subterraneous edifices where Atreus and his sons had deposited their treasures, and, among other sepulchral monuments, one of Agamemnon, and one of his fellow soldiers and sufferers.

Mycenæ || Myginda.

MYCONE, an island of the Archipelago, situated in E. Long. 25. 51. N. Lat. 37. 28. It is about 36 miles in circuit, and has a town of the same name, containing about 3000 inhabitants. The people of this island are said to be the best sailors in the Archipelago, and have about 150 vessels of different sizes. The island yields a sufficient quantity of barley for the inhabitants, and produces abundance of figs, and some olives; but there is a scarcity of water, especially in summer, there being but one well in the island.—There are a great number of churches and chapels, with some monasteries.

MYCONUS, in *Ancient Geography*, one of the islands called Cyclades, near Delos, under which the last of the Centaurs slain by Hercules are feigned to lie buried. Hence the proverb, *Omnia sub unam Myconum congerere*, applied to an injudicious or unnatural farrago. Myconii, the people, noted for baldness. Hence Myconius, a bald person. According to Strabo, the inhabitants became bald at the age of 20 or 25; and Pliny says that the children were always born without hair. The island was poor, and the inhabitants very avaricious; whence Archilochus reproached a certain Pericles, that he came to a feast like a Myconian; that is without previous invitation. Now called *Mycone*, which see.

MYCTERIA, the JABIRU, a genus of birds belonging to the order of grallæ. See ORNITHOLOGY *Index*.

MYGDONIA, in *Ancient Geography*, a district of Macedonia, to the north of the Sinus Thermaicus, and east of the river Axius, which separates it from Bottæis, and west of the river Strymon (Pliny). Also a district of Mesopotamia, which took its name from that of Macedonia, running along the Euphrates, from Zeugma down to Thapsacus, extending a great way east, because Nisibis was reckoned to it.

MYGINDA, a genus of plants belonging to the tetrandria class; and in the natural method ranking with those of which the order is doubtful. See BOTANY *Index*.

MYIAGRUS,

Myiagrus || Mylasa.

MYIAGRUS DEUS, in the heathen mythology, a name given sometimes to Jupiter, and sometimes to Hercules, on occasion of their being sacrificed to for the driving away the vast numbers of flies which infested the sacrifices on certain public occasions. The word is usually spelt *Myagrus*; but this must be an error, as this word does not express the *fly-destroyer*, but the *mouse-destroyer*; and we have it sufficiently testified by the ancients, that flies were the only creatures against whom this deity was invoked. Pliny calls this deity also *Myiodes*; and tells us that the flies which used to pester the Olympic rites went away in whole clouds on the sacrificing a bull to this god. We find in Athenæus also, that this sacrificing to the god of flies at the Olympic games was a constant custom. Some distinguish these two deities, and tell us that the latter or Myiodes, used to visit the nations in vengeance, with a vast multitude of flies: and that, on paying him the due honours of a sacrifice, they all went away again; and this seems to agree with what Pliny tells us in some places.

At the time of the Olympic games, Jupiter was worshipped under the name of *Apomyos* or *Myiagrus Deus*, to supplicate the destruction of those troublesome creatures. This happened only once in many years, when the sacrifices were performed there; but the Elians worshipped him continually under this name, to deprecate the vengeance of heaven, which usually sent, as they expressed it, an army of flies and other insects, toward the latter end of the summer, that infested the whole country with sickness and pestilence.

MYIODES DEUS, in the heathen mythology, a name sometimes given to Hercules, but more frequently to Jupiter, to whom a bull was sacrificed, in order to make him propitious in driving away the flies that infested the Olympic games.

MYLÆ, in *Ancient Geography*, a Greek city situated on an isthmus of a cognominal peninsula, on the north-east side of the island. *Mylaei*, or *Mylenses*, the people. A town built by those of Zancle (Strabo). Mylæus, the epithet, as Mylæus Campus, mentioned by Polybius. Now called *Milazzo*, a port town of Sicily, in the Val di Demona. E. Long. 15. 5. N. Lat. 38. 36.

MYLASA, or MYLASSA, in *Ancient Geography*, a noble city of Caria in Asia Minor, situated about three leagues from the *Sinus Ceramicus*. It was the capital of Hecatomnus king of Caria, and father of Mausolus. Pliny speaks of Menander king of Caria, and says that the Rhodians preserved with the greatest care his portrait painted by Apelles: but it was not in honour of this Menander that a Corinthian pillar was erected at Mylasa, which still exists, and on which is to be seen the following inscription: "The people erected this pillar in honour of Menander, the son of Uliades, and grandson of Euthydemus, the benefactor of his country, and whose ancestors rendered it great services also." Euthydemus, the grandfather of this Menander, lived in the time of Julius Cæsar and Augustus. Caria was taken by Mithridates, and afterwards by Labienus, whose father had been one of Cæsar's generals. Hybrias, whose eloquence and valour deservedly entitled him to a distinguished rank among his countrymen, in vain encouraged them to make a most obstinate defence while it was besieged by the latter. He himself was obliged to yield to necessity, and to take refuge at Rhodes: but scarcely had the conqueror quitted the city, when Hybrias returned, and restored liberty to his country.—Not content with rendering it this service, he also destroyed the power of a dangerous citizen, whose riches and talents rendered him a necessary evil. Euthydemus, often banished, and as often recalled, always too powerful in a state the independence of which he threatened, saw his ambition checked by the zeal and activity of Hybrias. The Romans left to Mylasa that liberty of which it rendered itself so worthy, by the great efforts it made to preserve it. Pliny calls it *Mylasa libera*. Strabo informs us, that it was one of the most magnificent cities of antiquity, and one of those, the temples, porticoes, and other public monuments of which were highly admired. A quarry of white marble in the neighbourhood furnished it with abundance of materials for erecting these edifices.—The Mylasians had two temples dedicated to Jupiter, one situated in the city, which was named *Osogo*, and another built on a mountain, at the distance of 60 leagues. The latter was dedicated to *Jupiter Stratius*, Jupiter the Warrior. His state, which was very ancient, inspired great veneration; people came from all quarters to implore his protection; and for the greater accommodation of his votaries a paved way was constructed which reached from Mylasa to this venerable fabric. This city is now called *Melasso*, and, according to Dr Chandler, is still a large place.—The houses are numerous, but chiefly of plaster, and mean, with trees interspersed. The air is accounted bad; and scorpions abound as anciently, entering often at the doors and windows, and lurking in the rooms. The plain is surrounded by lofty mountains, and cultivated. Round the towns are ranges of broken columns, the remnants of porticoes, now with rubbish bounding the vineyards. A large portion of the plain is covered with scattered fragments, and with piers of ordinary aqueducts; besides inscriptions, mostly ruined and illegible. Some altars dedicated to Hecatomnus have been discovered. Of all the ancient temples which formerly ornamented this city, one only escaped the power of time, the blind zeal of the early Christians, and the barbarous superstition of the Mahometans. This monument was dedicated to Augustus and the divinity of Rome. When Pococke visited Melasso, it was perfect and entire; but at present no traces of it remain, except a few fragments, which have been employed to construct a Turkish mosque.

Mylasa || Myomancy

MYLOGLOSSUM, in *Anatomy*. See ANATOMY, *Table of the Muscles*.

MYLOHYOIDÆUS. *Ibid.*

MYOLOGY, (formed of μυς, μυος, "a muscle," and λογος, "discourse"), in anatomy, a description of the muscles; or the knowledge of what relates to the muscles of the human body. *Ibid.*

MYOMANCY, a kind of divination, or method of foretelling future events by means of mice.

Some authors hold myomancy to be one of the most ancient kinds of divination; and think it is on this account that Isaiah, lxvi. 17. reckons mice among the abominable things of the Idolaters. But, beside that, it is not certain that the Hebrew word עכבר used by the

Myomancy || Myristica.

the prophet signifies *a mouse*, it is evident it is not the divination by that animal, be it what it will, that is spoken of, but the eating it.

MYOPIA, SHORT-SIGHTEDNESS; a species of vision wherein objects are seen only at small distances. See MEDICINE, N° 361.

MYOSOTIS, SCORPION-GRASS; a genus of plants belonging to the pentandria class, and in the natural method ranking under the 41st order, *Asperifoliæ*. See BOTANY *Index*.

MYOSURUS, a genus of plants belonging to the pentandria class, and in the natural method ranking under the 26th order, *Multisiliquæ*. See BOTANY *Index*.

MYOXUS, the DORMOUSE, a genus of quadrupeds belonging to the order of glires. See MAMMALIA *Index*.

MYRIAD, a term sometimes used to denote ten thousand.

MYRICA, GALE, or SWEET-WILLOW, a genus of plants belonging to the dicœcia class, and in the natural method ranking under the 5th order, *Amentaceæ*. See BOTANY *Index*.

MYRIOPHYLLUM, a genus of plants belonging to the moncœcia class, and in the natural method ranking under the 15th order, *Inundatæ*. See BOTANY *Index*.

MYRISTICA, the NUTMEG-TREE, in *Botany*, a genus of plants belonging to the class dicœcia, and order syngenesia, and of the natural order, *Lauri*. The description of this genus having been omitted in its proper place under BOTANY, we shall here introduce a short account of it.—The male calyx is monophyllous, strong, and parted into three *laciniæ* of an oval shape, and ending in a point: it has no corolla. In the middle of the receptacle rises a column of the height of the calyx, to the upper part of which the antheræ are attached. They vary in number from three to twelve or thirteen.—The female calyx and corolla as in the male, on a distinct tree. The germen of an oval shape; the style short, with a bifid stigma, the lacinii of which are oval and spreading.—The fruit is of that sort called *drupa*. It is fleshy, roundish, sometimes unilocular, sometimes bivalved, and bursts when ripe at the side. The seed is enveloped with a fleshy and fatty membranous substance which divides into filaments (this, in one of the species, is the mace of the shops). The seed or nutmeg is round or oval shaped, unilocular, and contains a small kernel, variegated on the surface by the fibres running in the form of a screw.

Species.—There are five species of this genus according to some authors; but several of these being only varieties, may be reduced into three, viz.

1. Myristica fatua, or wild nutmeg: this grows in Tobago, and rises to the height of an apple-tree; has oblong, lanceolated, downy leaves, and hairy fruit:—the nutmeg of which is aromatic, but when given inwardly is narcotic, and occasions drunkenness, delirium, and madness, for a time.

2. The myristica sebifera, (*Virola Sebifera* Aublet, page 904. tab. 345.) a tree frequent in Guiana, rising to 40 or even to 60 feet high; on wounding the trunk of which, a thick, acrid, red juice runs out. Aublet says nothing of the nutmegs being aromatic; he only observes, that a yellow fat is obtained from them, which serves many economical and medical purposes, and that the natives make candles of it. Myristica.

3. The myristica moschata, or nutmeg, rises to the height of 30 feet, producing numerous branches; the bark of the trunk is of a reddish brown, but that of the young branches is of a bright green colour: the leaves are nearly elliptical, pointed, undulated, obliquely nerved, on the upper side of a bright green, on the under whitish, and stand alternately upon footstalks: the flowers are small, and hang upon slender pedunculs, proceeding from the axillæ of the leaves: they are both male and female upon separate trees.

M. Schwartz, who has carefully examined this as well as the two first species, preserved in spirits, places them among the monadelphia.

The nutmeg has been supposed to be the *comacum* of Theophrastus, but there seems little foundation for this opinion; nor can it with more probability be thought to be the *chrysobalanos* of Galen. Our first knowledge of it was evidently derived from the Arabians; by Avicenna it was called *jiausiban*, or *jiausiband*, which signifies nut of Banda. Rumphius both figured and described this tree; but the figure given by him is so imperfect, and the description so confused, that Linnæus, who gave it the generic name *myristica*, was unable to assign its proper characters. M. Lamarck informs us, that he received several branches of the myristica, both in flower and fruit, from the isle of France, where a nutmeg-tree, which was introduced by Monsieur Poivre in 1770, is now very large, and continually producing flowers and fruit. From these branches, which were sent from Mons. Cere, director of the king's garden in that island, Lamarck has been enabled to describe and figure this and other species of the myristica. See Plate CXXIV. BOTANY.

Fig. *a*. A sprig with fructification. The drupa of the natural size, and bursting open. Fig. *b*. The full-grown fruit cut lengthwise. Fig. *c*. Another section of the same. Fig. *d*. The nutmeg enveloped with its covering, the mace. Fig. *e*. The fatty membrane or mace spread out. Fig. *f*. The nutmeg of its natural size. Fig. *g*. The same with its external tegument removed at one end. Fig. *h*. The same with its outer tegument entirely removed. Fig. *i*. A transverse section of the nutmeg.

The seeds or kernels called *nutmegs* are well known, as they have been long used both for culinary and medical purposes. Distilled with water, they yield a large quantity of essential oil, resembling in flavour the spice itself; after the distillation an insipid sebaceous matter is found swimming on the water; the decoction inspissated, gives an extract of an unctuous, very lightly bitterish taste, and with little or no astringency. Rectified spirit extracts the whole virtue of nutmegs by infusion, and elevates very little of it in distillation; hence the spirituous extract possesses the flavour of the spice in an eminent degree.

Nutmegs, when heated, yield to the press a considerable quantity of limpid yellow oil, which on cooling concretes into a sebaceous consistence. In the shops we meet with three sorts of unctuous substances, called *oil of mace*, though really expressed from the nutmeg. The best is brought from the East Indies in stone jars; this is of a thick consistence, of the colour of

mace,

Myristica. mace, and has an agreeable fragrant smell; the second sort, which is paler coloured, and much inferior in quality, comes from Holland in solid masses, generally flat, and of a square figure: the third, which is the worst of all, and usually called *common oil of mace*, is an artificial composition of sevum, palm oil, and the like, flavoured with a little genuine oil of nutmeg.

Method of gathering and preparing Nutmeg.—When the fruit is ripe the natives ascend the trees, and gather it by pulling the branches to them with long hooks. Some are employed in opening them immediately, and in taking off the green shell or first rind, which is laid together in a heap in the woods, where in time it putrefies. As soon as the putrefaction has taken place, there spring up a kind of mushrooms called *boleti moschatyni*, of a blackish colour, and much valued by the natives, who consider them as delicate eating. When the nuts are stripped of their first rind, they are carried home, and the mace is carefully taken off with a small knife. The mace, which is of a beautiful red, but afterwards assumes a darkish or reddish colour, is laid to dry in the sun for the space of a day, and is then removed to a place less exposed to his rays, where it remains for eight days, that it may soften a little. They afterwards moisten it with sea water, to prevent it from drying too much, or from losing its oil. They are careful, however, not to employ too much water, lest it should become putrid, and be devoured by the worms. It is last of all put into small bags, and squeezed very close.

The nuts which are still covered with their ligneous shell, are for three days exposed to the sun, and afterwards dried before a fire till they emit a sound when they are shaken; they then beat them with small sticks in order to remove their shell, which flies off in pieces. These nuts are distributed into three parcels, the first of which contains the largest and most beautiful, which are destined to be brought to Europe; the second contains such as are reserved for the use of the inhabitants; and the third contains the smallest, which are irregular or unripe. These are burnt; and part of the rest is employed for procuring oil by pressure. A pound of them commonly gives three ounces of oil, which has the consistence of tallow, and has entirely the taste of nutmeg. Both the nut and mace, when distilled, afford an essential, transparent, and volatile oil, of an excellent flavour.

The nutmegs which have been thus selected would soon corrupt if they were not watered, or rather pickled, with lime-water made from calcined shell fish, which they dilute with salt water till it attain the consistence of fluid pap. Into this mixture they plunge the nutmegs, contained in small baskets, two or three times, till they are completely covered over with the liquor. They are afterwards laid in a heap, where they heat, and lose their superfluous moisture by evaporation. When they have sweated sufficiently, they are then properly prepared, and fit for a sea voyage.

In the island of Banda, the fruit of the nutmeg tree is preserved entire in the following manner: When it is almost ripe, but previous to its opening, it is boiled in water and pierced with a needle. They next lay it in water to soak for ten days, till it has lost its sour and sharp taste. They then boil it gently in a syrup of sugar, to which, if they wish it to be hard, a little lime is added. This operation is repeated for eight days, and each time the syrup is renewed. The fruit when thus preserved is put for the last time into a pretty thick syrup, and is kept in earthen pots closely shut. Myristica

These nuts are likewise pickled with brine or with vinegar; and when they intend to eat them, they first steep them in fresh water, and afterwards boil them in syrup of sugar, &c.

Uses.—Nutmegs preserved entire are presented as desserts, and the inhabitants of India sometimes eat them when they drink tea. Some of them use nothing but the pulp; others likewise chew the mace; but they generally throw away the kernel, which is really the nutmeg. Many who perform sea voyages to the north chew this fruit every morning.

The medicinal qualities of nutmeg are supposed to be aromatic, anodyne, stomachic, and restringent; and with a view to the last-mentioned effects, it has been much used in diarrhœas and dysenteries.

Remarks on the trade of Nutmegs.—Nutmeg trees grow in several islands in the eastern ocean. The wood pigeon of the Moluccas is unintentionally a great planter of these trees, and disseminates them in places where a nation, powerful by its commerce, thinks it for its interest that they should be rooted out and destroyed. The Dutch, whose unwearied patience can surmount the greatest obstacles, formerly appropriated to themselves the crop of nutmeg, as well as that of cloves and cinnamon, growing in the islands of Ternate, Ceylon, &c. either by right of conquest or by paying subsidies to the islanders, who find these much more profitable than the former produce of their trees. It is nevertheless true, that they have prevailed upon or compelled the inhabitants of the Moluccas to cut down and root out all the clove trees, which they have preserved only in the islands of Amboyna and Ternate, which are in a great measure subject to them. We know for certain, that the Dutch pay 18,000 rixdollars yearly to the king of Ternate by way of tribute or gift, in order to recompense him for the loss of his clove trees in the other Molucca islands; and that they are moreover bound by treaty to take at 3½d. a pound, all the cloves brought by the natives of Amboyna to their magazines.

The Dutch had formerly immense and very rich magazines of these precious aromatics, both in India and Europe. It is said, that they had actually by them the produce of 16 years, and never supplied their neighbours with the last, but always with the oldest crop: in 1760 they sold what was laid up in 1744; and when they had too great a quantity of cloves, nutmeg, &c. in their magazines, they threw them into the sea, or destroyed them by burning. On the 10th of June 1760, M. Bomare saw at Amsterdam, near the Admiralty, a fire, the fuel of which was valued at 8,000,000 of livres; and as much was to be burned on the day following. The feet of the spectators were bathed in the essential oil of these substances; but no person was allowed to gather any of it, much less to take any of the spices which were in the fire. Some years before, upon a similar occasion, and at the same place, a poor man

Myristica || Myrrh.

man who had taken up some nutmegs which had rolled out of the fire, was, as M. Bomare was informed, seized and condemned to immediate execution.

But after all, although the spice trade is less exclusively limited to the Dutch of late years, it does not appear that the price of East Indian spiceries is in any degree reduced to the consumer.

MYRMECOPHAGA, or ANT-BEAR, a genus of quadrupeds, belonging to the order of bruta. See MAMMALIA *Index*.

MYRMELEON, or ANT-LION, a genus of insects of the neuroptera order. See ENTOMOLOGY *Index*.

MYRMIDONS, MYRMIDONES, in antiquity; a people in the southern borders of Thessaly, who accompanied Achilles to the Trojan war. They received their name from Myrmidon, a son of Jupiter and Eurymedusa, who married one of the daughters of Æolus, son of Helen. His son Actor married Ægina, the daughter of Æsopus. He gave his name to his subjects, who dwelt near the river Peneus in Thessaly. According to some, the Myrmidons received their name from their having arisen from ants or pismires, upon a prayer put up for that purpose by King Æacus to Jupiter, after his kingdom had been dispeopled by a severe pestilence. According to Strabo, they received it from their industry, because they imitated the diligence of the ants, and like them were indefatigable, and were continually employed in cultivating the earth.

MYRMILLONES were gladiators of a certain kind at Rome, who fought against the Retiarii. Their arms were a sword, head piece, and shield. On the top of the head-piece they wore a fish embossed, called Μορμυρος, whence their name is by some supposed to be derived. The Retiarii, in their engagements, made use of a net, in which they endeavoured to entangle their adversaries; and sung during the fight, "*Non te peto, piscem peto; quid me fugis, Galle?*" "I aim not at thee, but I aim at thy fish; why dost thou shun me, O Gaul!" The Myrmillones were called Galli, because they wore Gallic armour. They were also named *Secutores*. This kind of gladiators was suppressed by Caligula. See GLADIATORS, RETIARII, &c.

MYROBALANS, a kind of medicinal fruit brought from the Indies, of which there are five kinds. 1. The citrine of a yellowish red colour, hard, oblong, and the size of an olive. 2. The black or Indian myrobalan, of the bigness of an acorn, wrinkled and without a stone. 3. Chebulic myrobalans, which are of the size of a date, pointed at the end, and of a yellowish brown. 4. Emblic, which are round, rough, the size of gall, and of a dark brown. 5. Belleric, which are hard, round, of the size of an ordinary prune, less angular than the rest, and yellow. They are all slightly purgative and astringent. The word comes from the Greek μυρον, "ointment," and βαλανος, "acorn," as being in the form of acorns, and used in medicine.

MYRON, an excellent Grecian statuary, flourished 442 B. C. The cow he represented in brass was an admirable piece of workmanship, and was the occasion of many fine epigrams in Greek.

MYROXYLON, a genus of plants belonging to the decandria class. See BOTANY *Index*.

MYRRH, a gummy-resinous concrete juice, which is brought from the East Indies or from Abyssinia. See MATERIA MEDICA *Index*.

Myrrh || Mysia.

It is affirmed by some, that the myrrh we have at present is not equal in quality to that of the ancients, and has not that exquisite smell which all authors ascribe to the latter. They aromatized their most delicious wines with it; and it was presented as a very valuable perfume to our Lord while he lay in the manger.

It was this gum also which was mingled with the wine given him to drink at his passion, to deaden his pains, and produce a stupor. (See Mark xv. 32.). The gall mentioned on the same occasion by St Matthew is probably the same with myrrh; for any thing bitter was usually distinguished by the name of gall. The Hebrews were accustomed to give those that were executed some stupefying draught. The difficulty which arises from the seeming difference betwixt the two evangelists, by some is solved by saying, that St Matthew, writing in Syriac, made use of the word *marra*, which signifies "myrrh, bitterness, or gall;" but the Greek translator has taken it for gall, and St Mark for myrrh. Others think that our Saviour's drink was mingled with myrrh as a stupefying drug: but suppose that the soldiers out of wanton cruelty and inhumanity, infused gall; which was the reason, say they, why, when he had tasted, he refused to drink.

MYRRHINE, or MURRINE. See MURRINE.

MYRSINE, a genus of plants belonging to the pentandria class, and in the natural method ranking under the 18th order, *Bicornes*. See BOTANY *Index*.

MYRTIFORM, in *Anatomy*, an appellation given to several parts, from their resembling myrtle berries.

MYRTLE. See MYRTUS, BOTANY *Index*.

MYRTOUM MARE, a part of the Ægean sea, lying between Eubœa, Peloponnesus and Attica. It receives this name from Myrto a woman, or from Myrtos a small island in the neighbourhood, or from Myrtilus the son of Mercury who was drowned there, &c.

MYRTUS, in *Ancient Geography*, a small island near Carystus in Eubœa, which gave name to the mare Myrtoum. Others, according to Pausanias, derive the appellation from *Myrto*, the name of a woman. Strabo extends this sea between Crete, Argia, and Attica. Pausanias beginning it at Eubœa, joins it at Helena, a desert island, with the Ægean sea. Ptolemy carries it to the coast of Caria. Pliny says, that the Cyclades and Sporades are bounded on the west by the Myrtoan coast of Attica.

MYRTUS, the *Myrtle*, a genus of plants belonging to the icosandria class; and in the natural method ranking under the 19th order, *Hesperideæ*. See BOTANY *Index*.

MYSIA, a country of Asia Minor, generally divided into Major and Minor. Mysia Minor was bounded on the north and west by the Propontis and Bithynia, and Phrygia on the southern and eastern borders. Mysia Major had Æolia on the south, the Ægean sea on the west, and Phrygia on the north and east. Its chief cities were Cyzicum, Lampsacus, &c. The inhabitants were once very warlike; but they greatly degenerated, and the words *Mysorum ultimus* were emphatically used to signify a person of no merit. The ancients generally hired them to attend their funerals as

Mysia, Myson.

mourners, because they were naturally melancholy and inclined to shed tears. They were once governed by monarchs. They are supposed to be descended from the Mysians of Europe, a nation who inhabited that part of Thrace which was situated between Mount Hæmus and the Danube.

MYSON, a native of Sparta, one of the seven wise men of Greece. When Anacharsis consulted the oracle of Apollo, to know which was the wisest man in Greece, he received for answer, he who is now ploughing his fields. This was Myson.

Myson, Mysore.

MYSORE, or MYSOREAN DOMINIONS, a kingdom of Asia, in the East Indies, including the territories usurped or subdued by Hyder Ali, and transmitted to his son Tippoo Saib, but now subject to the British government. For an account of the conquest of which, see INDIA.

MYSTERIES.

1 The gradual introduction of mysteries into religion.

RELIGION, in its original form, was simple and intelligible. It was intended for the instruction and education of all ranks of men; and of consequence its doctrines were on a level with vulgar capacities. The Jewish dispensation was openly practised: nothing was performed in secret; every article was plain, open, and accessible. The divine Author of the Christian economy commanded his disciples to preach his doctrine in the most public manner: "What ye have heard in secret (says he) preach openly; and what I have taught you in private teach ye publicly, and proclaim it on the house tops." Such are the charms of truth, and such the character of that religion which came down from heaven, that they, as it were, "delight, and lift up their voice in the streets, and cry in the chief places of concourse."

But such is the depravity of the nature of man, that the noblest institutions degenerate in his hands. Religion itself, originally pure, simple, and amiable, under his management has often been transformed into pollution, perplexity, and deformity. The ministers of religion, whose province it was to guard the sacred deposite, and to secure it from foreign and spurious intermixtures, have generally been the first innovators, and the first and most industrious agents in corrupting its integrity and tarnishing its beauty. Avarice and ambition prompted that class of men to deviate from the original plainness and simplicity of religious institutions, and to introduce articles, rites, and usages, which might furnish them with opportunities of gratifying these unhallowed and insatiable passions. Hence distinctions unknown to pure and undefiled religion were fabricated; and that heavenly institution, heretofore, one, simple, indivisible, was divided into two partitions: the one popular and public; the other dark, secret, and mysterious. The latter of these we intend as the subject of this article.

2 Etymology and import of the term.

The English word *mystery* is derived from the Greek μυστηριον; and in its modern acceptation imports something above human intelligence, something awfully obscure and enigmatical; any thing artfully made difficult; the secret of any business or profession. The word is often used by the founder of the Christian religion, and more frequently by his apostles, especially St Paul. In these cases, it generally signifies those doctrines of Christianity which the Jews, prior to the advent of the Messiah, either did not or could not understand. The Trinity in Unity, and the Unity in Trinity; the incarnation of the Son of God; the union of two natures in one and the same person, &c. we generally call *mysteries*, because they are infinitely above human comprehension. All these significations are out of the question at present. Our intention in this article is to lay before our readers the fullest and fairest account we have been able to collect, of those απορρητα, or *secret rites*, of the Pagan superstition, which were carefully concealed from the knowledge of the vulgar, and which are universally known under the denomination of *mysteries*.

3 Object of this article.

The word μυστηριον is evidently deduced from μυστης; but the origin of this last term is not altogether so obvious. The etymologies of it exhibited by the learned are various; some of them absurd and inconsistent, others foolish and futile. Instead of fatiguing our readers with a detail of these, which would be equally unentertaining and uninteresting, we shall only produce one, which to us appears to come nearest the truth. The mysteries under consideration at present were certainly imported into Greece from the east. In those regions, then, we ought of course to look for the etymology of the word. *Mistor* or *mistur*, in Hebrew, signifies "any place or thing hidden or concealed." As this word implies a kind of definition of the nature of the thing intended, and as it is one of the excellencies of original languages to apply vocables with this propriety, we find ourselves strongly inclined to assign the word *mistur* as the root of the term μυστης, *myster*.

4 Motives to the introduction of the mysteries.

We have already observed, that the avarice and ambition of the Pagan priesthood probably gave birth to the institution of the mysteries. To this observation we may now add, that the ministers of that superstition might possibly imagine, that some articles of their ritual were too profound to be comprehended by the vulgar; others, too sacred to be communicated to a description of men, whom the institutions of civil society had placed in a situation not only subordinate but even contemptible. It was imagined, that things sacred and venerable would have contracted a taint and pollution by an intercourse with sordid and untutored souls. These appear to us the most probable motives for making that odious and pernicious distinction between the popular religion and that contained in the sacred and mysterious ritual.

The learned Bishop Warburton is positive, that the mysteries of the Pagan religion were the invention of legislators* and other great personages, whom fortune or their own merit had placed at the head of the civil societies which were formed in the earliest ages in different parts of the world. It is with reluctance, and indeed

* *Divin. Leg.*

5 The hypothesis of Warburton ill founded.

indeed with diffidence, that we presume to differ in our sentiments from such respectable authority. Whatever hypothesis this prelate had once adopted, so extensive was his reading, and so exuberant his intellectual resources, that he found little difficulty in defending it by an appearance of plausibility, if not of rational argumentation. The large quotations he has adduced from Plato and Cicero, do indeed prove that the sages and legislators of antiquity sometimes availed themselves of the influence derived from the doctrines of the mysteries, and from the authority they acquired by the opinion of their having been initiated in them; but that those men were the inventors and fabricators of them is a position for which his quotations do not furnish the most slender presumption. At the same time, we think it not altogether certain, that the doctrine of a divine Providence, and a future state of rewards and punishments, were revealed in the mysteries with all the clearness and cogency which is pretended by his lordship.

But granting that the fabric was raised by the hands of sages and legislators, we imagine it would be rather difficult to discover what emolument that description of men could propose to derive from the enterprise.—The institution was evidently, and indeed confessedly, devised to conceal from the million those very doctrines and maxims, which had they known and embraced them, would have contributed most effectually to dispose them to submit to those wise regulations which their governors and legislators wished most ardently to establish. Experience has taught, that nothing has a more commanding influence on the minds of the vulgar, than those very dogmas, which, according to the Bishop, were communicated to the initiated. A conviction of the unity of the Deity, of his wisdom, power, goodness, omnipresence, &c. the steady belief of the immortality of the human soul, and of a future state of rewards and punishments, have in all ages, and in all countries, proved the firmest supports of legal authority. The very same doctrines, in the dawn of Christianity, contributed, of all other methods, the most effectually to tame and civilize the savage (A) inhabitants of the northern regions of Europe. Supposing those principles to have been inculcated by the mysteries, the most prudent plan legislators could have adopted, would have been to publish them to all mankind. They ought to have sent forth apostles to preach them to the savages whom they had undertaken to civilize. According to the learned prelate, they pursued the opposite course, and deprived themselves of those very arms by which they might have encountered and overthrown all the armies of savagism.

6 Mysteries of Eleusis said to be revealed publicly in Crete. † Lib. v.

Of all the legislators of antiquity, the Cretan alone was prudent enough to foresee and adopt this rational plan. Diodorus the Sicilian informs us†, that the mysteries of Eleusis, Samothracia, &c. which were elsewhere buried in profound darkness, were among the Cretans taught publicly, and communicated to all the world. Minos, however, was a successful legislator; and his intercourse with Jupiter Idæus extended his influence and established his authority. He was not under the necessity of calling in the mysteries to his assistance: on the contrary, it is highly probable that the universal knowledge of the doctrines of the mysteries among his countrymen contributed in a considerable degree to facilitate his labour, and ensure his success.

The divine Author of the Christian economy, viewed in the light of a human legislator, saw the propriety of this procedure. Nothing was concealed in his institutions; nothing was veiled with mystery, or buried in darkness. The success was answerable to the wisdom of the plan. The million flocked to the evangelical standard: the gospel was preached to the poor, to the illiterate and the vulgar; and the meanest of mankind eagerly embraced its maxims. Wherever it prevailed, it produced civilization, morality, sobriety, loyalty, and every other private and social virtue.—Upon the supposition that the mysteries had contained and inculcated the principles and practices which the prelate supposes they did, the civilizers of mankind, legislators, magistrates, and princes, ought to have combined to make them public for the sake of their own tranquillity, and the more effectual support of their authority and influence.

7 Mysteries the offspring of Egyptian priestcraft; but

Upon the whole, we are inclined to believe that the mysteries were the offspring of Egyptian priestcraft. They were instituted with a view to aggrandize that order of men, to extend their influence, and enlarge their revenues. To accomplish those selfish projects, they applied every engine towards besotting the multitude with superstition and enthusiasm. They taught them to believe, that themselves were the distinguished favourites of heaven; and that celestial doctrines had been revealed to them, too holy to be communicated to the profane rabble, and too sublime to be comprehended by vulgar capacities. It is, we confess, exceedingly probable, that after the mysteries were instituted, and had acquired an exalted reputation in the world, legislators, magistrates, judges, and potentates, joined in the imposture, with the same views and from the same principles. Princes and legislators, who found their advantage in overawing and humbling the multitude, readily adopted a plan which they found so artfully fabricated to answer these very purposes. They had interest enough with the sacerdotal (B) mystagogues, to induce them to allow them to participate in those venerable rites which had already established the authority of that description of men in whose hands they were deposited. The views of both parties were exactly congenial. The respect, the admiration, and dependance on the million, were the ultimate objects of their ambition respectively.—Priests and princes were actuated by the very same spirit. The combination was advantageous, and of consequence harmonious. For these reasons we have taken the liberty of differing from his Lordship of Gloucester with respect

8 adopted by legislators, &c.

(A) The Germans, Russians, and Scandinavians, who were never thoroughly civilized till the gospel was preached among them.

(B) The mystagogues were the ministers who acted the chief part in celebrating the mysteries.

to the persons who first instituted the secret mysteries of the Pagan religion.

9 Hypothesis of Mosheim

Another writer of considerable reputation in the republic of letters, is of opinion, that the mysteries were entirely commemorative; that they were instituted with a view to preserve the remembrance of heroes and great men, who had been deified in consideration of their martial exploits, useful inventions, public virtues, and especially in consequence of the benefits by them conferred on their contemporaries.—According to him, the (c) mysteries of Mithras were established for this very purpose. It would be no difficult matter to prove that the Persian deity of that name was the sun, and that his name and insignia jointly ascertain the truth of this assertion. The same writer extends this observation to the mysteries of the Egyptians, Phœnicians, Greeks, Hetruscans; and in a word, to all the institutions of that species throughout the world.

10 singular and indefensible.

In opposition to this singular opinion, it may be argued, we think with some show of reason, that the method of preserving the memory of great and illustrious men generally adopted, was the establishing festivals, celebrating games, offering sacrifices, singing hymns, dances, &c. We can recollect no secret mysteries instituted for that purpose at least in their original intention. If any usage of the commemorative kind was admitted, it was superinduced at some period posterior to the primary institution. At the same time, upon the supposition that the orgia of Bacchus were the same with those of the Egyptian Osiris, and that the mysteries of Ceres exhibited at Eleusis were copied from those of the Egyptian Isis, and allowing that the former was the sun, and the latter the moon; it will be difficult to find out the human persons whose exploits, adventures, inventions, &c. were intended to be immortalized by those institutions. Upon the whole, the mysteries were performed in secret; they were intended to be communicated only to a few; of course had they been instituted with a view to immortalize the memory of heroes and great men, the authors would have acted the most foolish and inconsistent part imaginable.—Instead of transmitting the fame of their heroes with eclat to posterity, they would by this procedure have consigned it to eternal oblivion.

11 Our first position supported by the character of the priests of Egypt.

We must then recur to our first position. The mysteries were the offspring of bigotry and priestcraft; they originated in Egypt, the native land of idolatry. In that country the priesthood ruled predominant. The kings were engrafted into their body before they could ascend the throne. They were possessed of a third part* of all the land of Egypt. The sacerdotal function was confined to one tribe, and was transmitted unalienably from father to son. All the orientals, but more especially the Egyptians, delighted in mysterious and allegorical doctrines. Every maxim of morality, every tenet of theology, every dogma of philosophy, was wrapt up in a veil of allegory and mysticism. This propensity, no doubt, conspired with avarice and ambition to dispose them to a dark and mysterious system of religion. Besides, the Egyptians were a gloomy † race of men; they delighted in darkness and solitude. Their sacred rites were generally celebrated with melancholy airs, weeping, and lamentation. This gloomy and unsocial bias of mind must have stimulated them to a congenial mode of worship. In Egypt then we are to search for the origin of the mysteries. Both the nature of the institution and the genius of the people confirm this position; and historians, both ancient and modern, are agreed in admitting the certainty of the fact.

* *Diodor. Sicul.* lib. i.

† *Plutarch*

12 The Osiris and Isis of Egypt the Bacchus and Ceres of Greece.

The Osiris of Egypt, every body knows, was the original Bacchus; as the Isis of the same country was the Ceres of the Greeks. The rites of Osiris were performed with loud shrieks and lamentations when he was put into the coffin; and with the most extravagant mirth, when he was in a manner raised from the dead, or supposed to be found again. Their hymns were upon the whole always composed in melancholy affecting strains; and consisted of lamentations for the loss of Osiris, the mystic flight of Bacchus, the wanderings of Isis, and the sufferings ‡ of the gods. The Canaanites, who were a kindred tribe of the Mizraim or Egyptians, imitated them in their sacred rites. At Byblus, Berytus, Sidon, and afterwards at Tyre, they used particularly mournful dirges for the death of Adonis or Tammuz §, who was the same with the Egyptian Osiris, i. e. the sun.

‡ *Plut. Is. et Osir.*

§ *Ezek.* chap. viii. *and Nonni Dionys.*

13 Death of Osiris and wanderings of Isis.

The Egyptians, then, naturally inclined to gloom and secrecy, instituted a mode of worship congenial with their natural disposition of mind. The recess of the sun towards the southern hemisphere, was the death * of Osiris; the wanderings of Isis in search of her husband and brother, allegorically imported the longing of the earth † for the return of the fructifying influence of the solar heat.

* *Macrob. Saturn.*

† *Plut. Is. et Osir.*

When that luminary returned towards the summer solstice, and grain, trees, fruits, herbs, and flowers adorned the face of nature, another festival was celebrated of a very different complexion from that of the former. In this season all Egypt was dissolved in the most extravagant mirth and jollity. During the celebration of those festivals, the priests formed allegorical representations of the sun and the earth (D). They personified the one and the other, and allegorized their motions, aspects, relations, sympathies, accesses, recesses, &c. into real adventures, peregrinations, sufferings, contests, battles, victories, defeats, and so forth. These, in process of time, were held up to the vulgar as real occurrences; and these in a few ages became the most essential articles of the popular creed. From this source were derived the conquests of Dionysus or Bacchus, so beautifully exhibited by Nonnus in his Dionysiacs;

(c) Principio hoc ego quidem controversia vacare, arbitror, mysteria quæ vocantur, ritus fuisse idcirco institutos ne memoria periret veterum beneficiorum, inventorum, fatorum rerum gestarum quibus primi populorum conditores, aut alii præclari homines, decus nomen, et famam, inter suos sibi comparaverant. Neque hæc cuiquam sententia mirabilis videri poterit. *Cud. Syst. Intellect. ed. Moshemii*, p. 329.

(D) Isis, among the Egyptians, sometimes signifies the moon, and sometimes the earth.

Dionysiacs; the wanderings of Io, wonderfully adorned by Æschylus; and the labours of Hercules, afterwards usurped by the Greeks.

14 The Egyptians deified departed heroes.

Whether the Egyptians deified mortal men in the earliest ages has been much controverted. Jablonkski † has taken much pains to prove the negative. Diodorus ‡ assures us, that they paid their monarchs a kind of divine adoration, even in their lifetime. Plutarch tells us plainly §, that some were of opinion that Isis, Osiris, Horus, Anubis, Typhon, were once mortal persons, who were exalted into demons after their death. The Sicilian, in his history of Isis and Osiris, Pan, Hermes, &c. plainly represents them as human personages; and informs us, that the Egyptians imagined, that after their decease they transmigrated into particular stars. From these authorities, we are inclined to believe that the Egyptians, as well as the other Pagans, did actually deify persons who had distinguished themselves in their days of nature by prowess, wisdom, useful arts, and inventions. This was a constant practice among the Greeks, who probably learned it from the people in question.

† *Panth. Egypt.*
‡ Lib. i.
§ *Is et Osir.*

15 Secrets respecting the objects of worship revealed in the mysteries.

The exploits of these heroes had been disguised by allegorical traditions and hieroglyphical representations. They had been magnified beyond all dimensions, in order to astonish and intimidate the vulgar. They had been interlarded with the most extravagant fables, in order to gratify their propensity towards the marvellous. All these secrets were developed in the mysteries. The catechumens (E) were informed of every particular relating to the birth, the life, the exploits, the adventures, the misfortunes, and decease of those heroic personages, and when, and by what means, they had attained to the high rank of divinities. At the same time we think it highly probable, that those demi-gods were represented in their state of exaltation and heavenly splendour. The magicians of Egypt were abundantly qualified for exhibiting *angels in machines*. The souls of virtuous men, who had not been eminent enough to merit the honour of deification, were shown in all the perfection of Elysian felicity; and perhaps the souls of tyrants, and of the children of (F) Typhon, were shown in Tartarus, suffering all the extremes of infernal punishment. From these exhibitions the mystagogues might naturally enough take occasion to read their pupils suitable lectures on the happy tendency of a virtuous conduct, and the dishonour and misery consequent upon a contrary course. They might set before them immortal renown, deification, and Elysium, on the one hand, and eternal infamy and misery on the other. This will probably be deemed the chief advantage accruing from this institution.

16 Chief advantage of the mysteries.

Besides the communications above mentioned, the catechumens were taught many secrets of physiology, or the nature of the phenomena of the world. This Pharnutus * every where affirms, especially in his last book towards the end. Plutarch too informs us, that many of the Greek philosophers were of opinion, that most of the Egyptian fables were allegorical details of physical operations. Eusebius acquaints us †, that the physiology, not only of the Greeks, but likewise of the barbarians, was nothing else but a kind of science of nature, a concealed and dark theology, involved in fable and fiction, whose hidden mysteries were so veiled over with enigmas and allegories, that the ignorant million were as little capable of comprehending what was said as what was suppressed in silence. This, says he, is apparent from the poems of Orpheus and the fable of the Phrygians and Egyptians. Dionysius of Halicarnassus likewise observes ‡, that the fables of the Greeks detail the operations of nature by allegorics. Proclus § makes the same observation concerning the people in question. The Egyptians, says he, taught the latent operations of nature by fables.

* *De Nat. Deorum.*
† *Prop. Evangel.*
‡, † *Antiq. Rom.*
§ *In Tim.*

17 Physiological secrets expounded in the mysteries of Egypt.

These physiological secrets were no doubt expounded to the initiated; and that the Egyptian priests were deeply skilled in physiological science, can scarce be questioned, if we believe that Jannes and Jambres rivalled Moses with their enchantments. The preceding detail comprehends all that was revealed to the Epoptæ in the original Egyptian mysteries. What articles might have been introduced afterwards we cannot pretend to determine.

Be that as it may, one thing is certain, namely, that the vulgar were excluded from all those choice secrets, which were carefully reserved for the nobility and sacerdotal tribes. To them it was given to know the mysteries of the kingdom of darkness; but to those who were without, all was mystery and parable. While the laity fed on husks, the clergy and the quality feasted on royal dainties. The priests who had devised these allegories understood their original import, and bequeathed it as an inestimable legacy to their children. Here then we have the primary object of the mysteries, namely, to develope to the initiated the original and rational import of those allegorical and mystical doctrines which were tendered to the uninitiated, wrapt up in impenetrable allegory and obscurity. To the former, these were communicated and explained: The latter were obliged to stand at an awful distance, and retire as the *Procul, O procul este profani*, thundered in their ears.

These allegorical traditions originated in Egypt, (see MYTHOLOGY.) It was the general bias of the oriental genius. The Egyptians, however, according to the most authentic accounts (G), were the greatest proficients in that science. The original subject of these institutions were, we imagine, the articles we have specified above: but in process of time, according to the natural course of things, numerous improvements were made, and many new rites, ceremonies, usages, and even doctrines, were superinduced, which were utterly unknown to the original hierophants, (H). Simplicity is, for

(E) Catechumens were pupils who were learning the elements of any science.

(F) Typhon was the evil genius, or devil, of the Egyptians.

(G) As early as the age of Joseph, the Egyptians were skilled in the interpretations of dreams, divinations, &c. and in the age of Moses they were become wise men, magicians, &c.

(H) Hierophant imports a priest employed in explaining the doctrines, rites, &c. communicated to the initiated.

for the most part, one of the distinguishing characters of a new institution; but succeeding architects generally imagine that something is still wanting to complete the beauty, the regularity, the uniformity, the magnificence, and perhaps the conveniency of the structure. Hence, at length, it comes to be so overloaded with adventitious drapery, that its primary elegance and symmetry are altogether defaced. This was the case with the earliest Egyptian mysteries. Their subject was at first simple and easy to be comprehended; in time it became complex, intricate, and unintelligible.

18 Temples where the mysteries were celebrated.

In order to celebrate those mysteries with the greater secrecy, their temples were so constructed as to favour the artifice of the priests. The fanes, in which they used to execute their sacred functions, and to perform the rites and ceremonies of their religion, were subterraneous apartments, constructed with such wonderfull skill and dexterity, that every thing that appeared in them breathed an air of solemn secrecy. Their walls were covered with hieroglyphic paintings and sculpture, and the altar was situated in the centre of the apartment. Modern ‡ travellers have of late years discovered some vestiges of them, and bear witness to the above description of those dark abodes (I). In those subterraneous mansions, which the priests of that ingenious nation had planned with the most consummate skill, the kings, princes, and great men of the state, encountered the dangers and hardships contrived to prove their prudence, fortitude, patience, abstinence, &c. These were appointed to try their merit; and by these the hierophants were enabled to decide whether or not they were duly qualified for receiving that benefit. Upon these occasions we may believe, abundance of those magical tricks were exhibited, for which the magicians of Egypt were so much celebrated among the ancients. The strange and astonishing sights, the alternate successions of light and darkness, the hideous spectres exposed to view, the frightful howlings re-echoed by these infernal domes, the scenes of Tartarus and Elysium, exhibited alternately and in quick succession, must have made a deep and lasting impression on the mind of the affrighted votary (K). These scenes we shall describe more fully in the sequel.

‡ *Norden, Shaw, Pococke*, &c.

19 The Grecian infernal regions copied from the Egyptian mysteries.

From the scenes exhibited in celebrating the Egyptian mysteries, especially those of Isis and Osiris, the Greeks seem to have copied their ideas of the infernal regions, and the subterraneous mansions of departed souls. Many colonies of Egyptians settled in Greece. From these the ἀοιδοι (L), or most early bards of Greece, learned them imperfectly. Of course, we find Homer's account of the infernal regions, and of the state of departed souls, lame and incoherent. Succeeding bards obtained more full and more distinct information. Euripides and Aristophanes seem to have paved the way for the prince of Roman poets. Plato † and some of the other philosophers have shown by their descriptions or allusions, that the whole apparatus of Tartarus and Elysium had become a hackneyed topic some centuries before Virgil was born. This incomparable poet borrowed his ideas from Homer, Aristophanes, Euripides, Plato, &c. These, under his plastic hand, in the sixth Æncid, grew into a system beautiful, regular, uniform, and consistent. The materials he has employed were created to his hand; he had only to collect, polish, arrange, and connect them.—The sentiments collected from the Platonic philosophy, and the inimitable episode copied from the annals of Rome, by the masterly skill which he has displayed in the application of them, form the chief excellencies of the piece. For the rest, he could well dispense with going to Eleusis (M): every old woman in Athens and Rome could repeat them.

† *Phædo.*

20 Mysteries brought from Egypt into Persia and Greece.

Egypt was then the native land of mysteries as well as of idolatry. Every god and goddess respectively had their mysteries; but as those of Isis and Osiris were the most celebrated, they of course became principal objects of pursuit as well as of imitation to the neighbouring nations. These, as is generally believed, were carried into Persia by Zoroastres, or Zerdusht, by whom they were consecrated to Mithras. On these we shall make some observations in the sequel.—Orpheus imported them into Thrace; Cadmus brought them into Bœotia, where they were sacred to Bacchus. Inachus established them at Argos in honour of Juno, the same with Isis (N); Cyniras in Cyprus, where they were dedicated to Venus. In Phrygia they were sacred to Cybele, the mother of the gods.

Our learned readers, who will probably reflect that the Egyptians were in ancient times inhospitable to strangers, will perhaps be surprised that this fastidious and jealous people were so ready to communicate the arcana of their religion to foreigners.—But they will please recollect, that a great part of Greece was planted with colonies from Egypt, Phœnicia, Palestine, &c. This we could easily prove, did the bounds prescribed us admit such a digression. Orpheus, if not an Egyptian, was at least of oriental extraction. Inachus, Cadmus, and Melampus, are universally allowed to have been Egyptians. Erechtheus, in whose reign the Eleusinian mysteries were established, was an Egyptian by birth, or at least sprung from Egyptian ancestors. The Egyptians, then, in those early ages, did not view the Greeks in the light of aliens, but as a people nearly related either to themselves or the Phœnicians, who were their brethren. Upon this connexion we imagine it was, that in later times most of the sages of Greece,

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(I) See an excellent description of these subterraneous abodes, and of the process of probation carried on there, in a French romance, entitled *the Life of Sethos.*

(K) Persons who had descended into Trophonius's vault were said to have been so terrified with shocking sights, that they never laughed during the remainder of their lives.

(L) These were strolling poets like our minstrels, who frequented the houses of the great men of Greece, and entertained the company upon public occasions with singing and tales of other times.

(M) Bishop Warburton has, with much ingenuity, and a vast profusion of reading, endeavoured to prove that Virgil borrowed the whole scenery of the sixth Æneid from the sources mentioned in the text.

(N) Isis was the moon, and the original Juno was the same planet.

Greece, especially of Athens, found so hospitable a reception among that people. They probably viewed them in the light of propagandi; apostles able and willing to disseminate their idolatrous rites. This observation, which might be supported by numberless authorities, did the nature of the present inquiry permit, will, we think, go a great way towards obviating the objection.

21 Mysteries of Mithras Bacchus, and Ceres, the most august.

Although, as has been observed, every particular deity had his own peculiar mysterious sacred rites, yet of all others those of Mithras, Bacchus (O), and Ceres, were deemed the most august, and were most universally and most religiously celebrated. To these, therefore, we shall in a good measure confine ourselves, upon this occasion. If our readers shall become intimately acquainted with these, they may readily dispense with the knowledge of the rest, which are, indeed, no more than streams and emanations from these sources. We shall then, in the first place, present to our readers a brief sketch of the mysteries of Mithras.

MITHRAS, or, according to the Persian, *Mihr*, was one of the great gods of the Asiatics. His worship was for many ages confined to Persia. Afterwards, however, it was propagated so far and wide, that some have imagined they had discovered vestiges of it even in Gaul. *Mihr*, according to Dr Hyde *, signifies love, and likewise the *sun*. If we might presume to differ from so a respectable an authority, we should conjecture that it is a cognate of the Hebrew word *muthir*, "excellentia, præstantia." That there was an analogy between the Hebrew and old Persian, is generally admitted by the learned. Be that as it may, Mithras was the sun (P) among the Persians; and in honour of that luminary this institution was established. Mithras, according to Plutarch (Q), was the middle god between Oramaz and Arimanes, the two supreme divinities of Persia. But the fact is, the solar planet was the visible emblem of Oramaz, the good genius of the Persian tribes, and the same with the Osiris of the Egyptians. From these people, some have imagined that Zoroastres (R), or Zerdusht, borrowed his mysteries of Mithras. To this opinion we cannot give our assent, because the probationary trials to be undergone by the candidates among the former were much more savage and sanguinary than among the latter.—Both, however, were instituted in honour of the same deity; and probably the scenes exhibited, and the information communicated in both, were analogous; a circumstance which perhaps gave birth to the opinion above mentioned.

* *Relig. vet. Persarum.*

22 Account of the mysteries of Mithras.

The grand festival of Mithras was celebrated six days, in the middle of the month Mihr (S). Upon these days, it was lawful for the kings of Persia to get drunk and dance. On this festival, we imagine, the candidates for initiation, having duly proved their vocation, were solemnly admitted to the participation of the mysteries.

Zoroastres (T) worshipped Mithras, or the Sun, in a certain natural cave, which he formed into a temple, and fitted up in a manner exactly mathematical. There Mithras was represented as presiding over the lower world with all the pomp of royal magnificence. In it too were seen the symbols of Mithras and of the world, philosophically and mathematically exhibited, to be contemplated and worshipped. This deity was sometimes represented as mounted on a bull, which he is breaking, and which he kills with a sword. On some bas reliefs still existing, he appears as a young man with his tiara turned upward, after the manner of the Persian kings. He is clothed with a short tunic and breeches, after the Persian fashion. Sometimes he wears a small cloak. By his sides are seen other human figures, with tiaras of the same fashion on their heads, but without cloaks. One of these figures commonly holds in his one hand a torch lifted up; in the other, one turned downward. Sometimes over the cave are seen the chariots of the sun and moon, and divers constellations, such as cancer, scorpio, &c.

23 Probationary exercises previous to initiation.

In one of those caves the ceremonies of initiation were performed; but before the candidate could be admitted, he was forced to undergo a course of probationary exercises, so numerous and so rigorous, that very few had courage and fortitude enough to go through them. He was obliged to live a life of virtue and abstinence for the space of seven years previous to the period of his initiation. Some months before it, he was obliged to submit to a long and austere fast, which continued fifty days. He was to retire several days to a deep and dark dungeon, where he was successively exposed to all the extremes of heat and cold. Meantime he frequently underwent the bastinado, which the priests applied without mercy. Some say this fustigation continued two whole days, and was repeated no less than 15 times. In the course of these probationary exercises, the candidate was generally reduced to a skeleton: and we are told, that there have been several instances of persons who have perished in the attempt.

Upon the eve of the initiation, the aspirant was obliged to* brace on his armour, in order to encounter

* *Jul. Firmicus.*

(O) Bacchus was the Osiris of the Egyptians, and Ceres was Isis of the same people.

(P) Mosheim, in his note on Cudworth's Intellectual System, p. 330. has taken much pains to prove that Mithras was a deified mortal; but we cannot agree with that learned man in this point.

(Q) Isis and Osiris, p. 369. l. 20. from the bottom. This philosopher makes Zoroaster, according to some, 5000 years prior to the Trojan war. This date is certainly extravagant. We cannot, however, agree, with some moderns, who make him contemporary with Darius Hystaspes, the immediate successor of Cambyses, because it contradicts all antiquity.

(R) M. Silohwette, Disser. v. p. 17. asserts that Zornastes was initiated among the Egyptians.

(S) The month Mehr began September 30. and ended October 30.

(T) See Dr Hyde de Rel. vet. Pers. pages 16, 17. Mr Bryant's Anal. vol. i. p. 232. Porphyr. de Antro Nymph. p. 254. This philosopher often mentions the cave of Mithras, and always attributes the institution of his rites to Zoroaster.

ter giants and savage monsters. In those spacious subterraneous mansions a mock hunting was exhibited. The priests and all the subordinate officers of the temple, transformed into lions, tygers, leopards, boars, wolves, and other savage creatures, assailed him with loud howlings, roaring, and yelling, and every instance of ferine fury. In those mock combats, the hero was often in danger of being really worried, and always came off with bruises and wounds. Lampridius informs us, that when the emperor Commodus was initiated, he actually carried the joke too far, and butchered one of the priests who attacked him in the figure of a wild beast. The Persians worshipped Mithras or the Sun by a perpetual fire; hence the votary was obliged to undergo a fiery trial; that is, to pass seven times through the sacred fire, and each time to plunge himself into cold water. Some have made these probationary penances amount to 80: others have thought that they were in all only 8. As we find no good authority for either of these numbers, we think ourselves at liberty to hazard the following conjecture: The number *seven* was deemed sacred over all the east. The Mithriac penances we imagine were either seven, or if they exceeded it, were regulated by seven repetitions of that number. The candidate having undergone all these torturing trials with becoming patience and fortitude, was declared a proper subject for initiation. But before his admission he was obliged to bind himself by the most solemn oath, with horrible imprecations annexed, never to divulge any single article of all that should be communicated to him in the course of his initiation.

24 Oath of secrecy.

25 Revelations in the mysteries of Mithras.

What ἀπορρήτα or *ineffable secrets* were imparted to the initiated, it is impossible at this distance of time to discover with any tolerable degree of certainty. We may, however, rest assured, that the most authentic tradition concerning the origin of the universe; the nature, attributes, perfections, and operations, of Oromasd; the baleful influences of Ariman; and the benign effects of the government of Mithras, were unfolded and inculcated. The secret phenomena of nature, as far as they had been discovered by the Magi, were likewise exhibited; and the application of their effects, to astonish and delude the vulgar, were taught both in theory and practice. The exercise of public and private virtues was warmly recommended; and vice represented in the most odious and frightful colours. Both these injunctions were, we may suppose, enforced by a display of the pleasures of Elysium and the pains of Tartarus, as has been observed above in describing the mysteries of the Egyptians.

Those initiations are mentioned by Lampridius in the life of Commodus, and likewise by Justin † and Tertullian ‡, who both flourished in the second century. The last of these two speaks of a kind of baptism, which washed from the souls of the initiated all the stains which they had contracted during the course of their lives prior to their initiation. He at the same time mentions a particular mark which was imprinted upon them (U), of an offering of bread, and an emblem of the resurrection; which particulars, however, he does not describe in detail. In that offering, which was accompanied with a certain form of prayer, a vessel of water was offered up with the bread. The same father elsewhere informs us, that there was presented to the initiated a crown suspended on the point of a sword; but that they were taught to say, *Mithras is my crown*. By this answer was intimated, that they looked upon the service of that deity as their chief honour and ornament.

† *Dial. cum Tryphone.*
‡ *De præscript adver. Hæret.*

After that the Teletæ (X) were finished, the pupil was brought out of the cave or temple, and with great solemnity proclaimed a lion of Mithras (Y); a title which imported strength and intrepid courage in the service of the deity. They were now consecrated to the god, and were supposed to be under his immediate protection; an idea which of course animated them to the most daring and dangerous enterprises.

The worship of Mithras was introduced into the Roman empire towards the end of the republic, where it made very rapid progress. When Christianity began to make a figure in the empire, the champions for Paganism thought of proposing to men the worship of this *power of benevolence*, in order to counterbalance or annihilate that worship which the Christians paid to Jesus Christ the true *Sun* of righteousness. But this mode was soon abolished, together with the other rites of Paganism. The Persian grandees often affected names compounded with Mithras; hence Mithridates, Mithrobarzanes, &c. Hence, too, the precious stone called *Mithridat* †, which by the reflection of the sun sparkled with a variety of colours. There is likewise a certain pearl of many different colours, which they call *Mithras*. It is found among the mountains near the Red sea; and when exposed to the sun, it sparkles with a variety of dyes. We find likewise a king of Egypt of that name, who reigned at Heliopolis; who being commanded in a dream to erect an obelisk to the solar deity, reared a most prodigious one in the neighbourhood of that city.

† *Solinus*, cap. 10.

26 Mithras said to have sprung from a rock.

The votaries of Mithras pretended that he was sprung from a rock, and that therefore the place where the mysterious ceremonies were communicated to the initiated was always a cave. Many different reasons have been assigned for the origin of this rock-born deity, most of which appear to us unsatisfactory. If our readers will be obliging enough to accept of a simple and obvious conjecture, they may take the following:

A

(U) In allusion to this practice of imprinting a sacred mark, probably on the forehead of the initiated, we find the injunction to the angel, Ezek. chap. ix. ver. 4. and the Revelation *passim*.

(X) The mysteries were called *Teletæ*, which imports, "the rites which confer perfection."

(Y) *Tertull. adv. Marc.* p. 55. The priests of Mithras were called the *lions of Mithras*, and his priestesses *lionesses*; some say *lycænas*. The other inferior ministers were called *eagles*, *hawks*, *ravens*, &c. and on their festivals they wore masks corresponding to their titles, after the Egyptian manner, where the priests appeared at the ceremonies with masks resembling the heads of lions, apes, dogs, &c. a circumstance which furnishes a presumption that the mysteries of Mithras were of Egyptian original.

A rock is the symbol of strength and stability (z); the dominion of Mithras, in the opinion of his votaries, was firm as a rock, and stable as the everlasting hills. If our readers should not admit the probability of this conjecture, we would beg leave to remit them to the learned Mr Bryant's *Analysis of Mythology*, where they will find this point discussed with deep research and wonderful ingennity. Whatever may have been the origin of this opinion with relation to the birth of Mithras, it is certain that some reverence to rocks and caves was kept up a long time even after the establishment of Christianity. Hence the prohibition given to some of the proselytes to that religion, that they should no more presume to offer up their prayers *ad petras*, at the rocks (A).

We shall conclude our account of the mysteries of Mithras, with a passage from M. Anquetil, to whom we are so much indebted for what knowledge we have of the Persian theology, and in which the functions of that deity are briefly and comprehensively delineated. "The peculiar functions of Mithras are to fight continually against Ahriman and the impure army of evil genii, whose constant employment is to scatter terror and desolation over the universe; to protect the frame of nature from the demons and their productions. For this purpose he is furnished with a thousand ears and a thousand eyes, and traverses the space between heaven and earth: his hands armed with a club or mace. Mithras gives to the earth light and sun: he traces a course for the waters: he gives to men corn, pastures, and children; to the world virtuous kings and warriors; maintains harmony upon earth, watches over the law," &c. As the history of Mithras, and the nature of his mysteries, are not generally known, we imagined it would be agreeable to many of our readers to have the most important articles relating to that subject laid before them as it were in detail.

27 Mysteries of Bacchus.

We now proceed to the orgia or mysteries of Bacchus, which we shall introduce with a brief history of that deity. The original Dionysus or Bacchus was the Osiris of the Egyptians, which last was the Sun (B). Whether there was an Egyptian monarch of that name, as Diodorus Siculus affirms *, has no manner of connexion with the present disquisition. The Greek name of that deity is plainly oriental, being compounded of *di*, "bright," and *nasta* or *nasa*, in the Æolic dialect *nusa*, "a prince." This name was imported from the east by Orpheus, Cadmus, or by whoever else communicated the worship of Osiris to the Greeks. That the Dionysus of the Greeks was the same with the Osiris of the Egyptians, is universally allowed. Herodotus tells us expressly †, that *Osiris* is *Dionysus* in the Greek language: Martianus Capellus, quoted above, expresses the very same idea ‡. The original Osiris was then the sun; but the Dionysus or Bacchus of the Greeks was the same with the Osiris of the Egyptians; therefore the Bacchus or Dionysus of the Greeks was likewise the same luminary.

* Lib. i.

28 Bacchus the same with Osiris.

† Lib. ii. cap 144.
‡ *Theol. Egypt.* lib. ii. cap. 1.

The name *Osiris* has much embarrassed critics and etymologists. The learned Jablonski §, instead of delineating the character, attributes, operations, adventures, exploits, and peculiar department assigned this deity by his votaries, has spent much of his pains on trying to investigate the etymology of his name. If it be granted, which is highly probable, that the Hebrew and Egyptian tongues are cognate dialects, we should imagine that it is actually the *Chosher* or *Oshir* of the former language, which imports, "to make rich, to become rich." Indeed the words *Osiris* and *Isis* were not the vulgar names of the sun and moon among the Egyptians, but only epithets importing their qualities. The name of the sun among that people was *Phri* or *Phry*, and that of the moon *Ioh*, whence the Greek *Io*. The term *Osiris* was applied both to the sun and to the river Nile; both which by their influence contributed respectively to enrich and fertilize the land of Egypt.

§ *Panth. Egypt.*

It was a general custom among the orientals to denominate their princes and great men from their gods, demigods, heroes, &c. When the former were advanced to divine honours, they were in process of time confounded with their archetypes. The original divinities were forgotten, and these upstart deities usurped their place and prerogatives. In the earliest periods of the Egyptian monarchy, there appeared two illustrious personages, Osiris and Isis. These were the children of Cronus; and being brother and sister, they were joined in matrimony, according to the custom of the Egyptians. As the brother and husband had assumed the name of the *Sun*, so the sister and consort took that of *Isis*, that is, "the woman ‖," a name which the Egyptians applied both to the moon and to the earth, in consequence of the similarity of their nature, their mutual sympathy, and congenial fecundity. Osiris having left his consort Isis regent of the kingdom, with Hermes as her prime minister, and Hercules as general of her armies, quitted Egypt with a numerous body of troops, attended by companies of fauns (C), satyrs, singing women, musicians, &c. and traversed all Asia to the eastern ocean. He then returned homeward through the Upper Asia, Thrace, Pontus, Asia Minor, Syria, and Palestine. Wherever he marched he conferred numberless benefits on the savage inhabitants. He taught the art of cultivating the ground, preserving the fruits of the earth, and distinguishing the wholesome and nutritive from the unwholesome and poisonous. He instructed them in the culture of the vine; and where vines could not be produced, he communicated to them the method of producing a fermented liquor from barley, very little inferior to wine itself. He built many cities in different

‖ *Horapollo*, cap. 3.

29 Exploits of Osiris.

(z) Our Saviour probably alludes to this emblem, when he talks of *building his church on a rock*; and adds, *that the gates of hell should not prevail against it.*

(A) The Caledonian druids seem to have regarded certain stones with a superstitious veneration, in which the Catholics imitated them. There are in several places of Scotland large stones, which the vulgar call *leere* stones, i. e. we imagine, *lecture*.

(B) See Macrob. lib. i. cap. 21. p. 247. bottom. Diogenes Laert. in proœmio, par. 10. Martian. Capel. lib. ii. Jablonski, vol. i. lib. ii. 415. par. 3. Plut. Isis et Osir. *passim*.

(C) Men and women dressed in the habits of those rural deities.

parts of the globe, planted numerous colonies (D), and wherever he directed his course instituted just and wholesome laws, and established the rites and ceremonies of religion, and left priests and catechists of his train to teach and inculcate the observance of them. In short, he left everywhere lasting monuments of his progress, and at the same time of his generosity and beneficence. Where he found the people docile and submissive, he treated them with kindness and humanity: if any showed themselves obstinate, he compelled them to submit to his institutions by force of arms.

At the end of three years, he returned to Egypt, where his brother Typhon, a wicked unnatural monster, had been forming a conspiracy against his life. This traiterous design he soon after accomplished in the following manner: He invited Osiris, with some other persons whom he had gained over, to an entertainment. When the repast was finished, he produced a beautiful coffer, highly finished, and adorned with studs of gold; promising to bestow it on the person whom it should fit best. Osiris was tempted to make the experiment. The conspirators nailed down the cover upon him, and threw the coffer into the river. This coffer, which was now become the coffin of Osiris, was, they tell us, wafted by the winds and waves to the neighbourhood of Byblus, a city of Phœnicia, where it was cast on shore, and left by the waves at the foot of a tamarind tree.

30 His death.

31 Wanderings of Isis in search of his body.

Isis in the mean time, disconsolate and forlorn, attended by Anubis, was ransacking every quarter in search of her beloved Osiris. At length being informed by her faithful attendant and guardian, that his body was lodged somewhere in the neighbourhood of Byblus, she repaired to that city. There, they say, she was introduced to the queen, and after (E) a variety of adventures she recovered the corpse of her husband, which, of course, she carried back with her to Egypt: but the mischievous Typhon, ever on the watch, found her on the banks of the Nile; and having robbed her of her charge, cut the body into 14 parts, and scattered them up and down. Now, once more, according to the fable, Isis set out in quest of those parts, all of which, only one excepted, she found, and interred in the place where she found them; and hence the many tombs of Osiris in that country. These tombs were denominated *taposins* by the natives. Many other fabulous adventures were ascribed to those two personages, which it is not our province to enumerate at present. If our readers should wish to be more minutely informed on this subject, they may have recourse to the authors mentioned in the last-quoted author, or to the learned Mr Bryant's Analysis of Ancient Mythology, and M. Cour de Gebelin, where they will find matter enough to gratify their curiosity.

32 The mysteries of Isis and Osiris instituted in commemoration of those adventures.

To commemorate those adventures, the mysteries of Isis and Osiris were instituted; and from them both those of Bacchus and Ceres, among the Greeks, were derived. Of the Egyptian solemnity, we have an exact epitome in one of the fathers of the church, to the following purpose: "Here follows (says he) an epitome of the mysteries of Isis and Osiris. They deplore annually, with deep lamentations and shaved heads, the catastrophe of Osiris over a buried statue of that monarch. They beat their breasts, mangle their arms, tear open the scars of their former wounds; that by annual lamentations the catastrophe of his miserable and fatal death may be revived in their minds. When they have practised these things a certain number of days, then they pretend that they have found the remains of his mangled body; and having found them, their sorrows are lulled asleep, and they break out into immoderate joy." What maxims of morality, secrets of physiology, or phenomena of astronomy, were couched under this allegorical process, is not our business to investigate in this place. We shall only observe, that, in all probability, Osiris and Isis were sovereigns of Egypt at a very early period; that they had conferred many signal benefits on their subjects, who, influenced by a sense of gratitude, paid them divine honours after their decease; that in process of time they were confounded with the sun and the moon; and that their adventures were at length magnified beyond all credibility, interlarded with fables and allegories, and employed in the mysteries as channels to convey a variety of instructions to the initiated.

33 Transferred to Byblus and Tyre, where Osiris was called *Adonis* and *Bacchus*.

Be that as it may, it is certain that the very same mode of worship was established at Byblus, and in after ages transferred to Tyre. The Mizraim and Chanaanim were nearly connected by blood, and their religious ceremonies were derived from the very same source. By what medium the worship of Osiris at Abydus and Tyre was connected, we shall leave to others to explain; we shall only observe, that among the Phœnicians this deity obtained the names *Adonis* and *Bacchus*. The former is rather an (F) epithet than a name: the latter is evidently an allusion to the weeping and lamentation (G) with which the rites were performed. We find another name of that divinity mentioned in Scripture (H); but that term is plainly of Egyptian original: we shall now proceed to the mysteries of Osiris as they were celebrated among the Greeks and Thracians, under the name of the *Orgia of Dionysus* or *Bacchus* †.

† *Diod Sicul. Vossius de Idol.*

Orpheus, the celebrated Thracian philosopher, had travelled into Egypt in quest of knowledge; and from that

(D) Many have thought this expedition fabulous; but the numberless monuments of Egyptian architecture, sculpture, and statuary, lately discovered in the east, confirm it.

(E) For the conquests and adventures of Osiris and Isis, we must send our learned readers to Diod. Sic. Bibl. l. i. and Plut. Isis et Osiris, p. 256. et seq. which we have been obliged to abridge, in consequence of the narrow limits prescribed us.

(F) Adonis is evidently the Hebrew *Adoni*, "my lord," and imports the sovereignty of the deity.

(G) Bacchus is derived from the Phœnician word *bahah*, "to weep." This was the name embraced by the Romans.

(H) Ezek. chap. viii. ver. 14. *Tammuz* is the name of one of the months of the Egyptian year.

that country, according to the most authentic accounts, he imported the Bacchanalian rites and institutions. Some have affirmed that this same Orpheus being intimately acquainted with the family of Cadmus, communicated these rites to them, and endeavoured to transfer them to the grandson of that hero, which grandson became afterwards the Grecian Bacchus. It is, however, we think much more probable, that those rites were imported from Egypt or Phœnicia, by (I) Cadmus himself, who was a native of the former country, and is thought to have spent some time in the latter, before he emigrated in quest of a settlement in Bœotia. It is said that Semele, the daughter of Cadmus, and the mother of the Grecian Bacchus, was struck with lightning at the very instant of his birth. The child was, in all probability, denominated *Bacchus* (K), from the sorrow and lamentation this melancholy accident had occasioned in the family. Cadmus, in order to conceal the dishonour of his daughter, might, we imagine, convey away his infant grandson to some of his relations in Phœnicia or Egypt. There he was educated and instructed in all the mysteries of Isis and Osiris, and at the same time initiated in all the magical or juggling tricks of the Egyptian priests and hierophants. Thus accomplished, when he arrived at manhood, he returned to Thebes with the traditional retinue of the original deity of the same name; and claimed divine honours accordingly. This claim, however, was not admitted without much opposition; Pentheus, another grandson of Cadmus, was torn to pieces by the frantic Bacchanalians upon Mount Citheron, because he attempted to interrupt them in celebrating the orgia. Some have thought that Cadmus lost his kingdom for the same reason; but this we think is by no means probable: we should rather imagine that the old prince was privy to the whole process, and that it was originally planned by him, with a view to attract the veneration of his new subjects, by making them believe that there was a divinity in his family.

34 and thence imported by Cadmus into Bœotia.

35 The actions of Osiris attributed to the Grecian Bacchus.

Be that as it may, the vain-glorious Greeks attributed all the actions of the Egyptian hero to their new Bacchus; and according to their laudable practice, engaged him in numberless adventures in which his prototype had no share. Most of those are futile and unentertaining (L). The Greeks commonly adopted some oriental personage as the hero of their mythological rhapsodies. Him they naturalized and adopted into some Grecian family, and so he became their own. To him they ascribed all the adventures and exploits of the oriental archetype from whom he was copied. Consequently in the orgia (M), every thing was collected that had been imported from the east relating to Osiris; and to that farrago was joined all that the Grecian rhapsodists had thought fit to invent, in order to amuse the credulous multitude. This, however, was not the whole of the misfortune: The adventures of Osiris were described by the Egyptian hierophants, veiled with allegorical and hieroglyphical mysteries. These the persons who imported them into Greece did not thoroughly comprehend, or, if they did, they were not inclined to communicate them sound and unsophisticated. Besides, many oriental terms were retained, the import of which was in process of time lost or distorted. Hence the religious ceremonies of the Greeks became a medley of inconsistencies. The mysteries of Bacchus, in particular, were deeply tinctured with this meretricious colouring; the adventures of the Theban pretender were grafted upon those of the Egyptian archetype, and out of this combination was formed a tissue of adventures disgraceful to human nature, absurd, and inconsistent. Indeed the younger or Theban Bacchus seems to have been a monster of debauchery; whereas the Egyptian is represented as a person of an opposite character. Of course the mysteries of the former were attended with the most shocking abominations.

36 Mysteries of Bacchus spread into Greece, &c.

These mysteries, as has been observed above, were first celebrated at Thebes the capital of Bœotia, under the auspices of the family of Cadmus. From this country they gradually found their way into Greece, and all the neighbouring parts of Europe. They were celebrated once every three years (N), because at the end of three years Osiris returned from his Indian expedition. As the Greeks had impudently transferred the actions of the Egyptian hero to their upstart divinity, the same period of time was observed for the celebration of those rites in Greece that had been ordained for the same purpose in Egypt.

37 Process of their celebration.

When the day appointed for the celebration of the orgia (O) approached, the priests issued a proclamation, enjoining all the initiated to equip themselves according to the ritual, and attend the procession on

(I) Cadmus and Melampus, who were both Egyptians, introduced the Bacchanalia into Greece. The Egyptian or oriental name of Bacchus was *Dinusi*, that is, "the prince of light." Cadmus had learned the name *Bacchus* from the Phœnicians.

(K) We have omitted the immense farrago of fable relating to the connexion between Jupiter and Semele as of little importance to our readers.

(L) Nonnus, an Egyptian of Pentapolis, has collected all the fabulous adventures of Bacchus, and exhibited them in a beautiful but irregular poem: To this we must refer our learned readers. Of the Dionysiacs we have a most judicious sketch, *Gebelin. Calend.* p. 553. et seq.

(M) The orgia belonged to all the Mydones, but to those of Bacchus in a peculiar manner.

(N) Hence these orgia were called *Triteria*.

(O) According to Clem. Alexand. Cohort. page 12. Pott. the word *orgia* is derived from *orge*, which signifies "anger," and originated from the resentment of Ceres against Jupiter, in consequence of a most outrageous insult he had offered her with success. We should rather imagine it derived from the Hebrew word *argoz*, signifying a "chest or coffer," alluding to the casket which contained the sacred symbols of the god.—The Egyptians or Phœnicians might write and pronounce, argoz, *orgoz*, or in some manner nearly resembling *orgia*.

the day appointed. The votaries were to dress themselves in coats of deer-skins, to loose the fillets of their hair, to cover their legs with the same stuff with their coats, and to arm themselves with thyrsi, which were a kind of spears wholly of wood entwined with leaves and twigs of the vine or ivy. It is said that the Bacchanalians, especially the Thracians, used often to quarrel and commit murder in their drunken revels; and that in order to prevent those unlucky accidents, a law was enacted, that the votaries, instead of real spears, should arm themselves with those sham weapons which were comparatively inoffensive. The statue of the deity, which was always covered with vine or ivy leaves was now taken down from its pedestal, and elevated on the shoulders of the priests. The cavalcade then proceeded nearly in the following manner:

First of all, hymns were chanted in honour of Bacchus, who was called the *Power of dances, smiles, and jests;* while at the same time he was deemed equally qualified for the exploits of war and heroism. Horace, in some of his dithyrambic odes, has concisely pointed out the subjects of those Bacchanalian songs. In the collection of hymns fabulously attributed to Orpheus, we find several addressed to this deity (P), each under a different title, derived from the different appellations of the god. All these names are of oriental original, and might easily be explained, did the bounds prescribed us admit of etymological disquisitions.

The hymn being finished, the first division of the votaries proceeded, carrying a pitcher of wine, with a bunch of the vine. Then followed the he-goat; an animal odious to Bacchus, because he ravages the vines. The chanting the hymns, the sacrificing the he-goat, and the revels, games, and diversions, with which the celebration of those rites was attended, gave birth to the dramatic poetry of the Greeks; as the persons habited in the dress of Fauns, Sylvans, and Satyrs (Q), furnished the name of another species of poetry of a coarser and more forbidding aspect.

38 The mysterious coffer, with its contents.

Then appeared the mysterious coffer or basket, containing the secret symbols of the deity. These were the phallus (R), some grains of sesama, heads of poppies, pomegranates, dry stems, cakes baked of the meal of different kinds of corn, salt, carded wool, rolls of honey, and cheese; a child, a serpent (S), and a van (T). Such was the furniture of the sacred coffer carried in the solemn Bacchanalian procession. The inventory given by some of the fathers † of the church is somewhat different. They mention the dye, the ball, the top, the wheel, the apples, the looking-glass, and the fleece. The articles first mentioned seem to have been of Egyptian original; the last were certainly superinduced by the Greeks; in allusion to his being murdered and torn in pieces when he was a child by the machinations of Juno, who prevailed with the Titans to commit the horrid deed. These last seem to have been memorials of his boyish playthings; for, says Maternus, "the Cretans ‡, in celebrating the rites of the child Bacchus, acted every thing that the dying boy either said, or did, or suffered. They likewise (says he) tore a live bull in pieces with their teeth, in order to commemorate the dismembering of the boy." For our part, we think, that if such a beastly rite was practised, it was done in commemoration of the savage manner of life which had prevailed among men prior to the more humane diet invented and introduced by Isis and Osiris. Be that as it may, we learn from Porphyry §, that in the island of Chios they used to sacrifice a man to Bacchus, and that they used to mangle and tear him limb from limb. This was no doubt practised in commemoration of the catastrophe mentioned above.

† *Clem. Alexand.*

‡ *De Errore Prof. Gent.*

39 Human sacrifices.

§ *De Abstinentia.*

The orgia of this Pagan god were originally simple enough; but this unsophisticated mode was of no long continuance, for riches soon introduced luxury, which quickly infected even the ceremonies of religion. On the day set apart for this solemnity, men and women crowned with ivy, their hair dishevelled, and their bodies almost naked, ran about the streets, roaring aloud *Evohe* (U) Bacche. In this rout were to be seen people intoxicated at once with wine and enthusiasm, dressed like Satyrs, Fauns, and Sileni, in such scandalous postures and attitudes, with so little regard to modesty and even common decency, that we are persuaded our readers will readily enough forgive our omitting to describe them. Next followed a company mounted upon asses, attended by Fauns, Bacchanals, Thyades, Mimallonides, Naiads, Tityri, &c. who made the adjacent places echo to their frantic shrieks and howlings. After this tumultuous herd were carried the statues of Victory

40 Total contempt of decency.

(P) These stand between the 41 and 52; one to Lenæus, or the presser; one to Libnites, or the winnower; one to Bessareus, or the vintager; one to Sabazius the god of rest; to Myses, or the Mediator, &c.

(Q) Dacier, Casaubon, and other French critics, have puzzled and perplexed themselves to little purpose about the origin of this word, without considering that it was coeval to dramatic poetry.

(R) The phallus was highly respected by the Egyptians, and was used as the emblem of the fecundity of the human race.

(S) That reptile was in high veneration among the Egyptians. See Euseb. Præp. Evang. lib. i. page 26. Steph. where we have a minute detail of the symbolical properties of that creature, according to Taautos the great legislator of that people.

(T) Servius in Georg. I. Virg. ver. 166. Mystica *vannus* Iacchi. The van, says he, is an emblem of that purifying influence of the mysteries, by which the initiated were cleansed from all their former pollutions, and qualified for commencing a holy course of life.

(U) Clem. Alexand. Cohort. page 11. Pott. derives this word from *Cheveh*, the mother of mankind, who, first opened the gate to that and every other error; but we are rather inclined to believe that it comes from the oriental word *Hevé*, which signifies a "serpent;" which among the Egyptians was sacred to the sun, and was likewise the emblem of life and immortality. It then imported a prayer to Bacchus for life, vigour, health, and every other blessing.

Victory and altars in form of vine-sets, crowned with ivy, smoking with incense and other aromatics. Then appeared several chariots loaded with thyrsi, arms, garlands, casks, pitchers, and other vases, tripods, and vans. The chariots were followed by young virgins of quality, who carried the baskets and little boxes, which in general contained the mysterious articles above enumerated. These, from their office, were called *cistophoræ*. The phallophori (x) followed them, with a chorus of itophallophori habited like Fauns, counterfeiting drunk persons, singing in honour of Bacchus songs and catches suited to the occasion. The procession was closed by a troop of Bacchanalians crowned with ivy, interwoven with branches of yew and with serpents *. Upon some occasions, at those scandalous festivals, naked women whipped themselves, and tore their skin in a most barbarous manner. The procession terminated on Mount Citheron, when it set out from Thebes; and in other places, in some distant unfrequented desert, where the votaries practised every species of debauchery with secrecy and impunity. Orpheus saw the degeneracy of those ceremonies; and in endeavouring to reform them he probably lost his life. Pentheus suffered in the like attempt, being torn in pieces by the Bacchanalians on Mount Citheron, among whom were his own mother and his aunts. The Greeks, who were an airy jovial people, seem to have paid little regard to the plaintive part of the orgia; or rather, we believe, they acted with howling and frantic exclamations, often enhanced by a combination of drunkenness, ecstacy, and enthusiastic fury.

* Ovid. Met.

What secrets, religious, moral, political, or physical, were communicated to the votaries, it is impossible to determine with any degree of certainty.—One thing we may admit, namely, that the doctrines discovered and inculcated in the orgia, were originally the very same which the apostles of the sect had imbibed in Egypt and Phœnicia; and of which we have given a brief account near the beginning of this article. It is, however, probable, that the spurious or Theban Bacchus had superadded a great deal of his own invention, which, we may believe, was not altogether so sound and salubrious as the original doctrine. However that may be, the initiated were made to believe that they were to derive wonderful advantages from the participation of those rites, both in this life and that which is to come. Of this, however, we shall talk more at length by and bye, in our account of the Eleusinian mysteries.

41 Doctrines inculcated in the orgia.

To detail the etymology of the names of this Pagan deity, the fables relating to his birth, his education, his transformations, his wars, peregrinations, adventures, the various and multiform rites with which he was worshipped, would swell this article to a most immoderate size. If any of our readers should wish to be more minutely and more accurately acquainted with this subject, we must beg leave to remit them to Diod. Sic. Apollod. Bibl. Euripid. Bacchæ, Aristophanis Ranæ, Nonn. Dionys.; and among the moderns, to Bau. Mythol. Voss. de Orig. Idol. Mons. Fourmont, Reflexions sur l'origine des anciens peuples, Mr Bryant's Analys. and especially to Mons. Cour de Gebelin, Calendries ou Almanach. That prince of etymologists, in his account of the festival of Bacchus, has given a most acute and ingenious explication of the names and epithets of that deity. For our part, we have endeavoured to collect and exhibit such as we judged most important, most entertaining, and most instructive, to the less enlightened classes of our readers.

42 Eleusinian mysteries instituted in honour of Ceres.

We now proceed to the Eleusinian mysteries, which, among the ancient Greeks and Romans, were treated with a superior degree of awe and veneration. These were instituted in honour of Ceres, the goddess of corn; who, according to the most authentic accounts, was the Isis of the Egyptians. The mysteries of Osiris and Isis have been hinted at in the preceding part of this article. They were originally instituted in honour of the sun and moon, and afterwards consecrated to an Egyptian prince and princess; who, in consequence of their merits, had been deified by that people. We know of no more exact and brilliant description of the ceremonies of that goddess, in the most polished ages of the Egyptian superstition, than what we meet with in the witty and florid Apuleius †, to which we must take the liberty to refer our more curious readers. Our business at present shall be to try to investigate by what means, and upon what occasion, those mysteries were introduced into Attica, and established at Eleusis. A passage from Diodorus Siculus §, which we shall here translate, will, we think, throw no inconsiderable light on that abstruse part of the subject.

† Lib. ix.

§ Lib. i.

43 On what occasion introduced into Attica.

"In like manner with him (Cecrops), says that judicious historian, they tell us, that Erechtheus, a prince of Egyptian extraction, once reigned at Athens. Of this fact they produce the following evidence: A scorching drought, during the reign of this prince, prevailed over almost all the habitable world, except Egypt; which, in consequence of the humidity of its soil, was not affected by that calamity. The fruits of the earth were burnt up; and at the same time multitudes of people perished by famine. Erechtheus, upon this occasion, as he was connected with Egypt, imported a vast quantity of grain from that country to Athens. The people, who had been relieved by his munificence, unanimously elected him king. Being invested with the government, he taught his subjects the mysteries of Ceres at Eleusis, and the mode of celebrating the sacred ceremonies, having transferred from Egypt the ritual for that purpose. In those times the goddess is said to have made her appearance at Athens three several times; because, according to tradition, the fruits of the earth which bear her name were then imported into Attica. On this account the seeds and fruits of the earth were said to be the invention of that deity. Now the Athenians themselves acknowledge, that, in the reign of Erechtheus, the fruits of the earth having perished for want of rain, the arrival of Ceres in their country did actually happen, and that along with her the blessing of corn

(x) The phallus was the symbol of the fructifying power of Nature. The itophallus was the type of that power in act.

corn was restored to the earth. They tell us at the same time, that the teletæ and the mysteries of that goddess were then received and instituted at Eleusis."

Here then we have the whole mystery of the arrival of Ceres in Attica, and the institution of her mysteries at Eleusis, unveiled. The whole is evidently an oriental allegory. The fruits of the earth had been destroyed by a long course of drought: Egypt, by its peculiar situation, had been preserved from that dreadful calamity. Erechtheus, in consequence of his relation to the Egyptians, imported from their country a quantity of grain, not only sufficient for the consumption of his own subjects, but also a great overplus to export to other parts of Greece, Sicily, Italy, Spain, &c. Triptolemus, another Egyptian, was appointed by Erechtheus to export this superfluous store. That hero, according to Pherecydes, was the son of Oceanus and Tellus, that is, of the sea and the earth; because his parents were not known, and because he came to Eleusis by sea. The ship in which he sailed, when he distributed his corn to the western parts of the world, was decorated with the figure of a winged dragon: therefore, in the allegorical style of his country, he was said to be wafted through the air in a chariot drawn by dragons. Those creatures, every body knows, were held sacred by the Egyptians.

Wherever Triptolemus disposed of his corn, thither were extended the wanderings of Ceres. In order to elucidate this point, we must observe, that along with the grain imported from Egypt, Erechtheus, or Triptolemus, or both, transported into Attica a cargo of priests and priestesses from the temples of Busiris, a city which lay in the * centre of the Delta, where the goddess Isis had a number of chapels erected for her worship. The presidents of these ceremonies, like all other bigots, gladly laid hold on this opportunity of propagating their religious rites, and disseminating the worship of the deities of their country. That the Egyptian priests were zealous in propagating the dogmas of their superstition, is abundantly evident from the extensive spreading of their rites and ceremonies over almost all Asia and a considerable part of Europe. The Greek and Roman idolatry is known to have originated from them; and numberless monuments of their impious worship are still extant in Persia ‡, India, Japan, Tartary, &c. Our inference then is, that the worship of Isis was introduced into every country where Triptolemus sold or disposed of his commodities — Hence the wanderings of Ceres in search of her daughter Proserpine who is generally called *Core*. The famine occasioned by the drought destroying the fruits of the ground, imports the loss of Proserpine. The restoration of the corn in various parts of the earth, by fresh supplies from Egypt from time to time, imports the wanderings of Ceres in quest of Proserpine. The whole process is an oriental allegory. The disappearing of the fruits of the earth, of which Proserpine, or Persephone †, or Peresephone (Y), is the emblem, is the allegorical rape of that goddess. She was seized and carried off by Pluto, sovereign of the infernal regions. The seed committed to the earth in that dry season appeared no more, and was, consequently, said to dwell under ground with Pluto. It was then that Ceres, that is, corn imported from Egypt, set out in quest of her daughter. Again, when the earth recovered her pristine fertility, the Core, or maid, was found by her mother Ceres, that is, the earth; for Isis, among the Egyptians, frequently signified the earth. The wanderings of Isis in search of Osiris furnished the model for the peregrinations of Ceres.

44 Different names of Ceres.

Ceres, the Roman name of the goddess of corn, was unknown to the modern Greeks. They always denominated her *Damater* (Z), which is rather an epithet than a proper name. The Greeks, who always affected to pass for originals, we think, suppressed the Egyptian name on purpose, to conceal the country of that deity. As a proof of the probability of this conjecture, it may be observed, that they metamorphosed the wanderings of Isis in search of Osiris into the peregrinations of Ceres in quest of Proserpine. The Romans who were less ambitious of the character of originality, retained one of her oriental names (AA.) Ceres, says Diodorus, appeared thrice in Attica during the reign of Erechtheus; which seems to import, that fleets loaded with corn had thrice arrived in that country from Egypt during that period.

Cecrops, the first king of Attica, had established the worship of the Saitic Athena or Minerva in that region, and consecrated his capital to that deity. Erechtheus, in his turn, introduced the worship of Isis, or Damater, who in all appearance was the tutelar deity of Busiris his native city. The subjects of Cecrops were a colony of Saites, and readily embraced the worship of Minerva; but the aborigines of that district being accustomed to a maritime, perhaps to a piratical course of life, were more inclined to consecrate their city to Neptune the god of the sea, and to constitute him their guardian and protector. Cecrops by a stratagem secured the preference to Minerva his favourite divinity. Erechtheus, in order to give equal importance to his patroness,

45 Contentions at Athens respecting Minerva and Neptune, the immediate cause of fixing the mysteries at Eleusis.

* *Herod.* lib. i.

‡ *Asiatic Researches*, vol. i. and ii.

† *Plutarch. Isis et Osir.*

(Y) This word seems to be formed of two Hebrew terms, *pheri* "fruit," and *tzaphon*, or *tzephon*, "abscondit, recondidit."

(Z) Damater is compounded of the Chaldaic particle *da*, "the," and *mater*, "mother." As Isis often signified the earth, the Greeks naturally adopted that title; because, according to them, that element is the mother of all living. In the very same manner they discarded the word *Juno*, an original title of the moon, and substituted *Hera*, which intimates "mistress or lady."

(AA) According to some of the Latin etymologists, *Ceres*, or rather *Geres*, is derived from *gero*, "to bear, to carry," because the earth bears all things; or because that element is the general fruit-bearer. But as this term came to Italy immediately from the east, and not by the medium of Greece, we would rather incline to adopt an oriental etymology. The Hebrew word *cheres* signifies *arare*, "to plough;" a name naturally applicable to the goddess of husbandry.

patroness, had the address to institute the Eleusinian mysteries; and to accomplish his design laid hold on the opportunity above mentioned.

This appears to us the most probable account of the origin and institution of the Eleusinian mysteries; for which the Sicilian historian has indeed furnished the clue. We shall now proceed to detail some other circumstances which attended the original institution of these far-famed ceremonies.

* *Apollod. Bibl.* lib. iii. cap. 13.

45 Circumstances attending the first appearance of Ceres in Attica.

The archpriestess who personated the newly imported deity was entertained by one Celeus *, who was either viceroy of that petty district of which Eleusis was the capital, or some considerable personage in that city or its neighbourhood. Upon her immediate arrival, according to the fabulous relations of the Greeks, a farce was acted not altogether suitable to the character of a goddess whose mysteries were one day to be deemed so sacred and austere. These coarse receptions and other indecencies attending the first appearance of the goddess, that is, the Egyptian dame who assumed her character, were copied from the like unhallowed modes of behaviour practised on occasion of the solemn processions of her native country. These scommata, or coarse jokes, had an allegorical signification in Egypt; and among the most ancient Greeks the very same spirit was universally diffused by the oriental colonists who from time to time arrived and settled among them. In process of time they abandoned the figurative and allegorical style, in consequence of their acquaintance with philosophy and abstract reasoning. In the ceremonies of religion, however, the same allegorical and typical representations which had been imported from the east were retained; but the Grecian hierophants in a short time lost every idea of their latent import, and religious, moral, or physical interpretation. Accordingly, this shameful rencounter between Ceres and Banbo (BB), or Jambe, was retained in the mysteries, though we think it was copied from Egypt, as was said above, where even that obscene action was probably an allegorical representation of something very different from what appeared to the Greeks.

47 Ceres and Bacchus, who they were.

At the same time that Ceres arrived in Attica, Bacchus likewise made his appearance in that country. He was entertained by one Icarus; whom, as a reward for his hospitality, he instructed in the art of cultivating the vine, and the method of manufacturing wine. Thus it appears that both agriculture and the art of managing the vintage were introduced into Athens much about the same time. Ceres was no other than a priestess of Isis; Bacchus was no doubt a priest of Osiris. The arrival of those two personages from Egypt, with a number of inferior priests in their train, produced a memorable revolution in Athens, both with respect to life, manners, and religion. The sacred rites of Isis, afterwards so famous under the name of the Eleusinian mysteries, date their institution from this period.

When this company of propagandi arrived at Elensis, they were entertained by some of the most respectable persons who then inhabited that district. Their names, according to Clem. Alexand. were Banbo, Dysaulis, Triptolemus, Eumolpus, and Eubulus. From Eumolpus were descended a race of priests called Eumolpidæ, who figured at Athens many ages after. Triptolemus was an ox herd, Eumolpus a shepherd, and Eubulus a swine herd. These were the first apostles of the Eleusinian mysteries. They were instructed by the Egyptian missionaries; and they, in their turn, instructed their successors. Erechtheus, or, as some say, Pandion, countenanced the seminary, and built a small temple for its accommodation in Eleusis, a city of Attica, a few miles west from Athens, and originally one of the twelve districts into which that territory was divided. Here then we have arrived at the scene of those renowned mysteries, which for the space of near 2000 years were the pride of Athens and the wonder of the world.

48 Eleusinian mysteries divided into greater and lesser.

The mysteries were divided into the greater and lesser. The latter were celebrated at Agræ, a small town on the river Ilyssus: the former were celebrated in the month which the Athenians called Boedromion (CC); the latter in the month Anthesterion (DD). The lesser mysteries, according to the fabulous legends of the Greeks, were instituted in favour of the celebrated Hercules. That hero being commanded by Eurystheus to bring up Cerberus from the infernal regions, was desirous of being initiated in the Eleusinian mysteries before he engaged in that perilous undertaking. He addressed himself to Eumolpus the hierophant for that purpose. There was a law among the Eleusinians prohibiting the initiation of foreigners. The priest not daring to refuse the benefit to Hercules, who was both a friend and benefactor to the Athenians, advised the hero to get himself adopted by a native of the place, and so to elude the force of the law. He was accordingly adopted by one Pyolius, and so was initiated in the lesser mysteries, which were instituted for the first time upon that occasion. This account has all the air of a fable. The lesser mysteries were instituted by way of preparation for the greater.

49 Austerities and rites previous to initiation.

The person who was to be initiated in the lesser mysteries, as well as in the greater, was obliged to practise the virtue of chastity a considerable time before his admission. Besides, he was to bind himself by the most solemn vows not to divulge any part of the mysteries. At the same time, he was, according to the original institution, to be a person of unblemished moral character. These were preliminaries indispensably necessary in order to his admission. A bull was sacrificed to Jupiter, and the hide of that animal, called by a peculiar name (Διος Κωδιον) was carefully preserved and carried to Eleusis, where it was spread under the feet of the initiated. The candidate was then purified by bathing in the river Ilyssus, by aspersions with salt water or salt, with laurel, barley, and passing through

(BB) Apollod. Bib. ubi supra. Clem. Alexand. Cohort. page 17. where the story is told with very little reserve.

(CC) The third month of the Athenian year, answering to our September.

(DD) The eighth month, answering to our February; but Meursius makes it November.

through the fire; all which rites were attended with incantations and other usages equally insignificant and ridiculous. Last of all, a young sow was sacrificed to Ceres; and this animal, according to the ritual, behoved to be with pigs: and before it was killed it was to be washed in Cantharus, one of the three harbours which formed the Piræus.

50 into the lesser mysteries; of which

All these ceremonies duly performed, the candidate was carried into the hall appointed for the purpose of initiation. There he was taught the first elements of those arcana which were afterwards to be more fully and more clearly revealed in the more august mysteries of Eleusis. The pupils at Agræ were called *Mystæ*, which may intimate probationers; whereas those of Eleusis were denominated *Epoptæ*, importing that they saw as they were seen.

51 there were several stages, with long intervals between them.

The lesser mysteries were divided into several stages, and candidates were admitted to them according to their quality and capacity respectively. Those who were initiated in the lowest were obliged to wait five years before they were admitted to the greater. Those who had partaken of the second kind underwent a noviciate of three years; those who had been admitted to the third, one of two years; and those who had gone through the fourth were admitted to the greater at the end of one year; which was the shortest period of probation a candidate for that honour could legally undergo. Such was the process generally observed in administering the lesser mysteries.

52 None but natives of Athens originally admitted to the greater mysteries.

With respect to the greater mysteries, it is probable that originally none but the natives of Attica were admitted to partake of them. In process of time, however, the pale was extended so far and wide as to comprehend all who spoke the Greek language. All foreigners were debarred from those sacred rites. They tell us, however, that Hercules, Bacchus, Castor and Pollux, Æsculapius, and Hippocrates, were initiated in an extraordinary manner, from a regard to their high character and heroic exploits. All barbarians, too, were excluded; yet Anacharsis the Scythian was indulged that privilege, in consequence of his reputation for science and philosophy. All persons guilty of manslaughter, though even accidentally or involuntarily, all magicians, enchanters; in a word, all impious and profane persons, were expressly prohibited the benefit of this Pagan sacrament. At last, however, the gate became wider, and crowds of people, of all nations, kindreds, and languages, provided their character was fair and irreproachable, rushed in by it. In process of time the Athenians initiated even their infants; but this, we imagine, must have been a kind of lustration or purification, from which it was supposed that they derived a kind of moral ablution from vice, and were thought to be under the peculiar protection of the goddess.

53 Celebration lasted nine days; but

The celebration of the mysteries began on the 15th day of the month Boedromion; and, according to most ancient authors, lasted nine days. Meursius has enumerated the transactions of each day, which are much too numerous to fall within the compass of this article; we must therefore refer our curious reader to the author just mentioned. Some days before the commencement of the festival, the præcones, or public criers, invited all the initiated, and all the pretenders to that honour, to attend the festival, with clean hands and a pure heart, and the knowledge of the Greek language.

54 was performed only during the night.

On the evening of the 15th day of the month called *Boedromion* the initiations commenced. Our readers will observe, that all the most sacred and solemn rites of the Pagan superstition were performed during the night: they were indeed generally works of darkness. On this day there was a solemn cavalcade of Athenian matrons from Athens to Eleusis, in carriages drawn by oxen. In this procession the ladies used to rally one another in pretty loose terms, in imitation, we suppose, of the Isiac procession described by Herodotus, which has been mentioned above. The most remarkable object in this procession was the Mundus Cereris, contained in a small coffer or basket. This was carried by a select company of Athenian matrons, who, from their office, were styled *Camphoræ*. In this coffer were lodged the comb of Ceres, her mirror, a serpentine figure, some wheat and barley, the pudenda of the two sexes, and perhaps some other articles which we have not been able to discover. The procession ended at the temple, where this sacred charge was deposited with the greatest solemnity.

55 The Mundus Cereri

We have no description of the temple of Eleusis upon record. Pausanias intended to have described it; but says he was diverted from his design by a dream *. Strabo informs us that the mystic sanctuary was as large as a theatre, and that it was built by Ictinus †. In the porch, or outer part of this temple, the candidates were crowned with garlands of flowers, which they called *himera*, or "the desirable." They were at the same time dressed in new garments, which they continued to wear till they were quite worn out. They then washed their hands in a laver filled with holy water; a ceremony which intimated the purity of their hearts and hands. Before the doors were locked, one of the officers of the temple proclaimed with a loud voice a stern mandate, enjoining all the uninitiated to keep at a distance from the temple, and denouncing the most terrible menaces if any should dare to disturb or pry into the holy mysteries. Nor were these menaces without effect: for if any person was found to have crowded into the sanctuary even through ignorance, he was put to death without mercy. Every precaution having been taken to secure secrecy, the initiatory ceremonies now began. But before we describe these, we must lay before our readers a brief account of the ministers and retainers of these secrets of paganism.

* Lib. ix.

† See *Eleusis*.

56 Dress of the candidates.

57 Care to keep the uninitiated at a distance.

58 The hierophant.

The chief minister of these far-famed mysteries was the hierophant. He was styled *King*, and enjoyed that dignity during life, and was always by birth an Athenian. He presided in the solemnity, as is evident from his title. This personage, as we learn from Eusebius, represented the Demiurgus, or Creator of the world. "Now in the mysteries of Eleusis (says that father) the hierophant is dressed out in the figure of the demiurgus." What this demiurgus was, we learn from the same writer. As this whole institution was copied from the Egyptians, we may rest assured that the figure of the Eleusinian Demiurgus was borrowed from the same quarter. "As for the symbols of the Egyptians (says he, quoting from Porphyry ‡), they are of the following complexion. The Demiurgus, whom the Egyptians call *Cneph*, is figured

‡ *Prop. Evan.*

as a man of an azure colour, shaded with black, holding in his right hand a sceptre and in his left a girdle, and having on his head a royal wing or feather wreathed round." Such, we imagine, was the equipment of the Eleusinian hierophant. This person was likewise styled *Prophet*. He was to be of the family of the Eumolpidæ; was obliged to make a vow of perpetual chastity; and even his voice, hair, and attitude, were adjusted to the ritual.

59 The daduchus. The next minister was the daduchus, or torch-bearer; who, according to the father above quoted, was attired like the sun. This minister resembled the sun, because that luminary was deemed the visible type of the supreme Demiurgus, and his vicegerent in governing and arranging the affairs of this lower world.

60 The priests. The third was the person who officiated at the altar. He was habited like the moon. His office was to implore the favour of the gods for all the initiated. We should rather imagine, that the person at the altar, as he resembled the moon, was intended to represent the goddess herself: for the Egyptian Isis, who was the archetype of Ceres, was sometimes the moon and sometimes the earth.

61 The herald The sacred herald was another principal actor in this solemn exhibition. His province was to receive every thing, that, according to the ritual, was to be communicated to the novices; and he probably represented Thyoth or Thoth, that is Hermes or Mercury, the interpreter of the gods.

62 The curators, &c. Besides these, there were five epimeletæ or curators, of whom the king was one, who jointly directed the whole ceremonial. Lastly, There were ten priests to offer the sacrifices. There were no doubt many officers of inferior note employed upon these occasions; but these were only insignificant appendages, whose departments have not been transmitted to posterity.

After this detail of the ministers of this solemn service, we return to the *mystæ*, or candidates for initiation. Some of the fathers of the church † mention a hymn composed by the celebrated Orpheus, which was sung by the mystagogue or king upon that occasion. This hymn appears to us one of those spurious compositions which abounded in the first ages of Christianity, and which the pious apologists often adopted without sufficient examination. That some sacred hymn was chanted upon that occasion, we think highly probable; but that the one in question was either composed by Orpheus, or used at the opening of these ceremonies, to us appears somewhat problematical.

† *Justin. Euseb. Clem. Alex.*

Before the ceremony opened, a book was produced, which contained every thing relating to the teletæ. This was read over in the ears of the mystæ; who were ordered to write out a copy of it for themselves. This was book kept at Eleusis in a sacred repository,

63 The petroma. formed by two stones exactly fitted to each other, and of a very large size. This repository was called *petroma*. At the annual celebration of the greater mysteries, these stones were taken asunder, and the book taken out; which, after being read to the mystæ, was replaced in the same casement.

64 Commencement of the initiations. The initiations began with a representation of the wanderings of Ceres, and her bitter and loud lamentations for the loss of her beloved daughter. Upon this occasion, no doubt, a figure of that deity was displayed to the mystæ, while loud lamentations echoed from every corner of the sanctuary. One of the company having kindled a firebrand at the altar, and sprung to a certain place in the temple, waving the torch with the utmost fury, a second snatched it from him, roaring and waving it in the same frantic manner; and a third, fourth, &c. in the most rapid succession. This was done to imitate Ceres, who was said to have perlustrated the globe of the earth with a flaming pine in her hand, which she had lighted at Mount Etna.

65 Questions put to the mystæ. When the pageant of the goddess was supposed to arrive at Eleusis, a solemn pause ensued, and a few trifling questions were put to the mystæ: What these questions were, is evident from the answers. "I have fasted; I have drunk the liquor; I have taken the contents out of the coffer; and having performed the ceremony, have put them into the hamper: I have taken them out of the hamper, and put them again in the coffer." The meaning of these answers, we conjecture, was this: "I have fasted, as Ceres fasted while in search of her daughter; I have drunk off the wort as she drank when given her by Banbo; I have performed what Ceres taught her first disciples to perform, when she committed to them the sacred hamper and coffer." After these interrogatories, and the suitable responses, the *mundus Cereris* was displayed before the eyes of the mystæ, and the *mystagogue* or hierophant, or perhaps the sacred herald by his command, read a lecture on the allegorical import of those sacred symbols. This was heard with the most profound attention; and a solemn silence prevailed throughout the fane. Such was the first act of this religious farce, which perhaps consisted originally of nothing more.

66 Traditions respecting the origin of the universe, &c. After the exposition of the *mundus Cereris*, and the import of her wanderings, many traditions were communicated to the mystæ concerning the origin of the universe and the nature of things. The doctrines delivered in the greater mysteries, says Clem. Alex. "relate to the nature of the universe. Here all instruction ends. Things are seen as they are; and nature, and the things of nature, are given to be comprehended." To the same purpose Cicero: "Which points being explained and reduced to the standard of reason, the nature of things, rather than that of the gods, is discovered." The father of the universe, or the supreme demiurgus, was represented as forming the chaotic mass into the four elements, and producing animals, vegetables, and all kinds of organized beings, out of those materials. They say that they were informed of the secrets of the anomalies of the moon, and the eclipses of the sun and moon; and, according to Virgil,

Unde hominum genus, et pecudes, unde imber et ignes.

What system of cosmogony those hierophants adopted, is evident from the passage above quoted from Eusebius; and from the account immediately preceding, it was that of the most ancient Egyptians, and of the orientals in general. This cosmogony is beautifully and energetically exhibited in Plato's Timæus, and in the genuine spirit of poetry by Ovid in the beginning of his Metamorphoses.

67 Exploits of the gods, and The next scene exhibited upon the stage, on this solemn occasion, consisted of the exploits and adventures of the gods, demigods, and heroes, who had from time

to time, being advanced to divine honours. These were displayed as passing before the mystæ in pageants fabricated for that important purpose. This was the original mode among the Egyptians, and was no doubt followed by their Eleusinian pupils. These adventures were probably demonstrated to have been allegorical, symbolical, hieroglyphical, &c. at least they were exhibited in such a favourable point of view as to dispel those absurdities and inconsistencies with which they were sophisticated by the poets and the vulgar.

68 their origin.

With respect to the origin of those factitious deities, it was discovered that they had been originally men who had been exalted to the rank of divinity, in consequence of their heroic exploits, their useful inventions, their beneficent actions, &c. This is so clear from the two passages quoted from Cicero, by Bishop Warburton †, that the the fact cannot be contradicted. But that prelate has not informed us so precisely, whether the mystagogues represented them as nothing more than dead men, in their present state, or as beings who were actually existing in a deified state, and executing the functions assigned them in the rubric of Paganism. Another query naturally occurs; that is, to what purpose did the mystagogues apply this communication? That the hierophants did actually represent those deified mortals in the latter predicament, is obvious from another passage quoted from Cicero by the same prelate, which we shall transcribe as translated by him: "What think you of those who assert that valiant, or famous, or powerful men, have obtained divine honours after death; and that these are the very gods now become the objects of our worship, our prayers, and adoration? Euhemerus tells us, when these gods died, and where they lie buried. I forbear to speak of the sacred and august rites of Eleusis. I pass by Samothrace and the mysteries of Lemnos, whose hidden rites are celebrated in darkness, and amidst the thick shades of groves and forests." If, then, those deified mortals were become the objects of worship and prayers, there can be no doubt of the belief of their deified existence. The allusion to the Eleusinian and other Pagan mysteries towards the close of the quotation, places the question beyond the reach of controversy. But though, according to this account, "there were gods many and lords many;" yet it is evident from the passage quoted from Eusebius in the preceding part of this article, that the unity of the Supreme Being was maintained, exhibited, and inculcated. This was the original doctrine of the hierophants of Egypt: It was maintained by Thales and all the retainers of the Ionian school. It was the doctrine of Pythagoras, who probably gleaned it up in the country just mentioned, in connexion with many other dogmas which he had the assurance to claim as his own.

† *Div. Leg.*

69 Unity of the supreme Being maintained in the mysteries.

But however the unity, and perhaps some of the most obvious attributes, of the Supreme Author of nature, might be illustrated and inculcated, the tribute of homage and veneration due to the subordinate divinities was by no means neglected. The initiated were taught to look to the *dii majorum gentium* with a superior degree of awe and veneration, as beings endowed with an ineffable measure of power, wisdom, purity, goodness, &c. These were, if we may use the expression, the prime favourites of the Monarch of the universe, who were admitted into his immediate presence, and who received his behests from his own mouth, and communicated them to his subordinate officers, prefects, lieutenants, &c. These they were exhorted to adore; to them they were to offer sacrifices, prayers, and every other act of devotion, both on account of the excellency of their nature and the high rank they bore at the court of heaven. They were instructed to look up to hero gods and demigods, as being exalted to the high rank of governors of different parts of nature, as the immediate guardians and protectors of the human race; in short, as gods near at hand, as prompters to a virtuous course, and assistants in it; as ready upon all occasions to confer blessings upon the virtuous and deserving. Such were the doctrines taught in the teletæ with respect to the nature of the Pagan divinities, and the worship and devotion enjoined to be offered them by the mysteries.

70 Offices of the other gods.

71 Excellent plan for accomplishing the ends proposed in the mysteries.

As the two principal ends proposed by these initiations were the exercise of heroic virtues in men, and the practice of sincere and uniform piety by the candidates for immortal happiness, the hierophants had adopted a plan of operations excellently accommodated to both these purposes. The virtuous conduct and heroic exploits of the great men and demigods of early antiquity, were magnified by the most pompous eulogiums, enforced with suitable exhortations to animate the votaries to imitate so noble and alluring an example. But this was not all: the heroes and demigods themselves were displayed in pageants, or vehicles of celestial light. Their honours, offices, habitations, attendants, and other appendages, in the capacity of demons, were exhibited with all the pomp and splendour that the sacerdotal college were able to advise. The sudden glare of mimic light, the melting music stealing upon the ear, the artificial thunders reverberated from the roof and walls of the temple, the appearance of fire and ethereal radiance, the vehicles of flame, the effigies of heroes and demons adorned with crowns of laurel emitting rays from every sprig, the fragrant odours and aromatic gales which breathed from every quarter, all dexterously counterfeited by sacerdotal mechanism, must have filled the imagination of the astonished votaries with pictures at once tremendous and transporting: Add to this, that every thing was transacted in the dead of night amidst a dismal gloom; whence the most bright effulgence instantaneously burst upon the sight. By this arrangement the aspirants to initiation were wonderfully animated to the practice of virtue while they lived, and inspired with the hope of a blessed immortality when they died. At the same time, their awe and veneration for the gods of their country were wonderfully enhanced by reflecting on the appearances above described. Accordingly Strabo very judiciously observes, "that the mystical secrecy of the sacred rites preserves the majesty of the Deity, imitating its nature, which escapes our apprehension. For these reasons, in celebrating the teletæ, the demons were introduced in their deified or glorified state.

But as all the candidates for initiation might not aspire to the rank of heroes and demigods, a more easy and a more attainable mode of conduct, in order to arrive at the palace of happiness, behoved to be opened. Private virtues were inculcated, and these

too were to meet a condign reward. But alas! this present life is too often a chequered scene, where virtue is depressed and trodden under foot, and vice lifts up its head and rides triumphant. It is a dictate of common sense, that virtue should sooner or later emerge, and vice sink into contempt and misery. Here then the conductors of the mysteries, properly and naturally, adopted the doctrine of a future state of rewards and punishments. The dogma of the immortality of the human soul was elucidated, and carefully and pathetically inculcated. This doctrine was likewise imported from Egypt; for Herodotus * informs us, "that the Egyptians were the first people who maintained the immortality of the human soul." The Egyptian immortality, however, according to him, was only the metempsychosis or transmigration of souls. This was not the system of the ancient Egyptians, nor indeed of the teletæ. In these, a metempsychosis was admitted; but that was carried forward to a very distant period, to wit, to the grand Egyptian period of 36,000 years.

72 Private virtues inculcated in the mysteries, by the doctrine of a future state.

* *Lib.* ii.

73 Emblems of Elysium and Tartarus.

As the mystagogues well knew that the human mind is more powerfully affected by objects presented to the eyes than by the most engaging instructions conveyed by the ear, they made the emblems of Elysium and Tartarus pass in review before the eyes of their novices. There the Elysian scenes, so nobly described by the Roman poet, appeared in mimic splendour; and, on the other hand, the gloom of Tartarus, Charon's boat, the dog of hell, the Furies with tresses of snakes, the tribunal of Minos and Rhadamanthus, &c. were displayed in all their terrific state. Tantalus, Ixion, Sisyphus, the daughters of Danaus, &c. were represented in pageants before their eyes. These exhibitions were accompanied with most horrible cries and howlings, thunders, lightning, and other objects of terror which we shall mention in their proper place.

No contrivance could be better accommodated to animate the pupils to the practice of virtue on the one hand, or to deter them from indulging vicious passions on the other. It resembled opening heaven and hell to a hardened sinner. The practices inculcated in celebrating the mysteries are too numerous to be detailed in this imperfect sketch. The worship of the gods was strictly enjoined, as has been shown above. The three laws generally ascribed to Triptolemus were inculcated, 1. To honour their parents; 2. To honour the gods with the first fruits of the earth; 3. Not to treat brute animals with cruelty. These laws were imported from Egypt, and were communicated to the Eleusinians by the original missionaries. Cicero makes the civilization of mankind one of the most beneficial effects of the Eleusinian institutions: "Nullum mihi, cum multo eximia divinaque videntur Athenæ tuæ peperisse; tum nihil melius illis mysteriis, quibus ex agresti immanique vita, excultiad humanitatem, et mitigati sumus; initiaque, ut appellantur, ita revera principia vitæ cognovimus; neque solum cum lectitia vivendi rationem accepimus, sed etiam cum spe meliore moriendi." Hence it is evident that the precepts of humanity and morality were warmly recommended in these institutions. The virtue of humanity was extended, one may say, even to the brute creation, as appears from the last of Triptolemus's laws above quoted. Some articles were enjoined in the teletæ which may appear to us of less importance, which, however, in the symbolical style of the Egyptians, were abundantly significant. The initiated were "commanded to abstain from the flesh of certain birds and fishes; from beans, from pomegranates and apples, which were deemed equally polluting. It was taught, that to touch the plant of asparagus was as dangerous as the most deadly poison. Now, says Porphyry, whoever is versed in the history of the *visions*, knows for what reason they were commanded to abstain from the flesh of birds."

74 The three laws of Triptolemus.

75 The initiated bound themselves by oaths to observe the precepts of the mysteries.

The initiated then bound themselves by dreadful oaths to observe most conscientiously and to practise every precept tendered to them in the course of the teletæ; and at the same time never to divulge one article of all that had been heard or seen by them upon that occasion. In this they were so exceedingly jealous, that Æschylus the tragedian was in danger of capital punishment, for having only alluded to one of the Eleusinian arcana in a tragedy of his; and one of the articles of indictment against Diagoras the Melian was, his having spoken disrespectfully of the mysteries, and dissuaded people from partaking of them. It must then be allowed, that the institution of the mysteries was of infinite advantage to the Pagan world. They were indeed a kind of sacraments, by which the initiated bound themselves by a solemn vow to practise piety towards the gods, justice and humanity towards their fellow men, and gentleness and tenderness towards the inoffensive part of the brute creation. The Pagans themselves were so thoroughly convinced of this fact, that in their disputes with the apologists for Christianity, they often appealed to the teletæ, and contrasted their maxims with the most sublime doctrines of that heavenly institution.

In order to impress these maxims the more deeply upon the minds of the novices, and to fix their attention more stedfastly upon the lectures which were delivered them by the mystagogue or the sacred herald, a mechanical operation was played off at proper intervals during the course of the celebration. "Towards the end of the celebration (says Stobæus), the whole scene is terrible; all is trembling, shuddering, sweat, and astonishment. Many horrible spectres are seen, and strange cries and howlings uttered. Light succeeds darkness; and again the blackest darkness the most glaring light. Now appear open plains, flowery meads, and waving groves; where are seen dances and choruses; and various holy phantasies enchant the sight. Melodious notes are heard from far, with all the sublime symphony of the sacred hymns. The pupil now is completely perfect, is initiated, becomes free, released, and walks about with a crown on his head, and is admitted to bear a part in the sacred rites." Aristides de Myst. Eleus. calls Eleusis "a kind of temple of the whole earth, and of all that man beholds done in the most dreadful and the most exhilarating manner. In what other place have the records of fable sung of things more marvellous? or in what region upon earth have the objects presented to the eye borne a more exact resemblance to the sounds which strike the ear? What object of sight have the numberless generations of men and women beheld comparable to these exhibited in the ineffable mysteries?" To the same purpose, Pletho, in the oracles of Zoroastres, informs us, "that

76 Horrible spectres and pleasing scenes alternately exhibited.

"that frightful and shocking apparitions, in a variety of forms, used to be displayed to the mystæ in the course of their initiation." And a little after, he adds, "that thunder and lightning and fire, and every thing terrible which might be held symbolical of the divine presence, were introduced." Claudian, in his poem *De Rapta Proserpina*, gives an elegant, though brief, description of this phenomenon, which throws some light on the passages above quoted.

> *Jam mihi cernuntur trepidis delubra moveri*
> *Sedibus et clarum dis pergere culmina lucem,*
> *Adventum testata Dea, jam magnus ab imis*
> *Auditur fremitus terris, templumque remugit*
> *Cecropidum.*

The sight of those appearances was called the *Autopsia*, or "the real presence:" hence those rites were sometimes called *Epoptica*. The *Epoptæ* were actually initiated, and were admitted into the *Sanctum Sanctorum*, and bore a part in the ceremonial: whereas the *mystæ*, who had only been initiated in the lesser mysteries at Agræ, were obliged to take their station in the porch of the temple. The candidates for initiation bathed themselves in holy water, and put on new clothes, all of linen, which they continued to wear till they were quite torn, and then they were consecrated to Ceres and Proserpine. From the ceremony of bathing they were denominated *Hydrani;* and this again was a kind of baptismal ablution. Whether the phrases of *washing away sin, putting on the Lord Jesus Christ, putting off the old man with his deeds, putting on a robe of righteousness, being buried in baptism*, the words *mystery, perfect, perfection*, which occur so frequently in the New Testament, especially in the writings of the apostle St Paul, are borrowed from the Pagan mysteries, or from usages current among the Jews, we leave to our more learned readers to determine.

77 A kind of baptismal ablution in the mysteries.

The Epoptæ having sustained all those fiery trials, heard and seen every thing requisite, taken upon them the vows and engagements above narrated, and, in a word, having shown themselves good soldiers of Ceres and Proserpine, were now declared *perfect men*. They might, like Cebes's *virtuous man*, travel wherever they chose; those wild beasts (the human passions) which tyrannise over the rest of mankind, and often destroy them, had no longer dominion over them. They were now not only *perfect* but *regenerated* men. They were now crowned with laurel, as was said above, and dismissed with two barbarous words, Κογξ ὀμπαξ, *Konx ompax*, of which perhaps the hierophants themselves did not comprehend the import. They had been introduced by the first Egyptian missionaries, and retained in the sacra after their signification was lost. This was a common practice among the Grecks. In the administration of their religious ceremonies, they retained many names of persons, places, things, customs, &c. which had been introduced by the Phœnicians and Egyptians, from whom they borrowed their system of idolatry. These terms constituted the language of the gods, so often mentioned by the prince of poets. To us the words in question appear to be Syriac, and to signify, *Be vigilant, be innocent.*

78 The initiated declared perfect men.

Numerous and important were the advantages supposed to redound to the initiated, from their being admitted to partake of the mysteries, both in this life and that which is to come. First, They were highly honoured, and even revered by their contemporaries. Indeed, they were looked up to as a kind of sacred persons: they were, in reality, consecrated to Ceres and Proserpine. Secondly, They were obliged by their oath to practise every virtue, religious, moral, political, public, and private. Thirdly, They imagined, that sound advice and happy measures of conduct were suggested to the initiated by the Eleusinian goddesses. Accordingly, says Pericles the celebrated Athenian statesman, "I am convinced, that the deities of Eleusis inspired me with this sentiment, and that this stratagem was suggested by the principle of the mystic rites." There is a beautiful passage in Aristophanes's † comedy of the † Act i.
Ranæ to the very same purpose, of which we shall subjoin the following periphrasis. It is sung by the chorus of the initiated.

> Let us to flow'ry meads repair,
> With deathless roses blooming,
> Whose balmy sweets impregn the air,
> Both hills and dales perfuming.
> Since fate benign our choir has join'd,
> We'll trip in mystic measure;
> In sweetest harmony combin'd
> We'll quaff full draughts of pleasure.
> For us alone the pow'r of day
> A milder light dispenses;
> And sheds benign a mellow'd ray
> To cheer our ravish'd senses:
> For we beheld the mystic show,
> And brav'd Eleusis' dangers.
> We do and know the deeds we owe
> To neighbours, friends, and strangers.

Euripides, in his Bacchæ (E), introduces the chorus extolling the happiness of those who had been acquainted with God, by participating in the holy mysteries, and whose minds had been enlightened by the mystical rites. They boast, "that they had led a holy and unblemished life, from the time that they had been initiated in the sacred rites of Jupiter Idæus, and from the time that they had relinquished celebrating the nocturnal rites of Bacchus, and the banquets of raw flesh torn off living animals." To this sanctity of life they had no doubt engaged themselves, when they were initiated in the mysteries of that god. The Eleusinian Epoptæ derived the same advantages from their sacramental engagements. Fourthly, The initiated were imagined to be the peculiar wards of the Eleusinian goddesses. These deities were supposed to watch over them, and often to avert impending danger, and to rescue them when beset with troubles.—Our readers will not imagine that the initiated reaped much benefit from the protection of his Eleusinian tutelary deities; but it was sufficient that they believed

(E) Act I. near the beginning, and in many other places.

ed the fact, and actually depended upon their interposition. Fifthly, The happy influences of the teletæ, were supposed to administer consolation to the Epoptæ in the hour of dissolution; for, says Isocrates, "Ceres bestowed upon the Athenians two gifts of the greatest importance; the fruits of the earth, which were the cause of our no longer leading a savage course of life; and the teletæ, for they who partake of these entertain more pleasant hopes both at the end of life, and eternity afterwards." Another author * tells us, "that the initiated were not only often rescued from many hardships in their lifetime, but at death entertained hopes that they should be raised to a more happy condition." Sixthly, After death, in the Elysian fields, they were to enjoy superior degrees of felicity, and were to bask in eternal sunshine, to quaff nectar, and feast upon ambrosia, &c.

* *Aristides, de Myst. Eleus.*

79 Interestedness of the priests.

The priests were not altogether disinterested in this salutary process. They made their disciples believe, that the souls of the uninitiated, when they arrived in the infernal regions, should roll in mire and dirt, and with very great difficulty arrive at their destined mansion. Hence Plato introduces Socrates † observing, "that the sages who introduced the teletæ had positively affirmed, that whatever soul should arrive in the infernal mansions *unhousell'd* and *unanneal'd*, should lie there immersed in mire and filth." And as to a future state (says Aristides), "the initiated shall not roll in mire and grope in darkness; a fate which awaits the unholy and uninitiated." It is not hard to conceive with what a commanding influence such doctrines as these must have operated on the generality of mankind.

† *Phædo.*

80 Remarks of Diogenes and Antisthenes.

When the Athenians advised Diogenes to get himself initiated, and enforced their arguments with the above considerations, "It will be pretty enough (replied the philosopher) to see Agesilaus and Epaminondas wallowing in the mire, while the most contemptible rascals who have been initiated are strutting in the islands of bliss."

When Antisthenes was to be initiated in the Orphic mysteries, and the priest was boasting of the many astonishing benefits which the initiated should enjoy in a future state ‡, "Why, forsooth, (says Antisthenes), 'tis wonder your reverence don't e'en hang yourself in order to come at them the sooner."

‡ *Diog. Laert.*

81 All the world crowd to Eleusis.

When such benefits were expected to be derived from the mysteries, no wonder if all the world crowded to the Eleusinian standard. After the Macedonian conquests, the hierophants abated much of their original strictness. By the age of Cicero, Eleusis was a temple whither all nations resorted to partake of the benefits of that institution. We find that almost all the great men of Rome were initiated. The hierophants, however, would not admit Nero on account of the profligacy of his character. Few others were refused that honour; even the children of the Athenians were admitted. But this, we think, was rather a lustration or consecration, than an initiation. Perhaps it paved the way for the more august ceremony, as the Christian baptism does among us for the other sacrament.

82 Degeneracy of the mysteries.

That this institution gradually degenerated, can hardly be questioned; but how much, and in what points, we have not been able to investigate. The fathers of the church, from whom that charge is chiefly to be collected, are not always to be trusted, especially when they set themselves to arraign the institutions of Paganism. There were indeed several ancient authors, such as Melanthius, Menander, Sotades, &c. who wrote purposely on the subject in question; but their works are long since irrecoverably lost. For this reason, modern writers, who have professedly handled it, have not always been successful in their researches. The two who have laboured most indefatigably, and perhaps most successfully, in this field, are Meursius and Warburton. The former, in his *Liber Singularis*, has collected every thing that can be gleaned from antiquity relating to the ceremonial of these institutions, without, however, pointing out their original, or elucidating the end and import of their establishment. The latter has drawn them into the vortex of a system which has in many instances led him to ascribe to them a higher degree of merit than we think they deserve. These instances we would willingly have noticed in our progress, had the limits prescribed us admitted such a discussion.

If we may believe Diodorus the Sicilian, these mysteries, which were celebrated with such wonderful secrecy at Eleusis, were communicated to all mankind among the Cretans. This, however, we think, is rather problematical. We imagine that excellent historian has confounded the mysteries of Cybele with those of the Eleusinian Ceres. These two deities were undoubtedly one and the same, that is, the moon or the earth. Hence it is probable, that there was a striking resemblance between the sacred mysteries of the Cretans and Eleusinians.

This institution continued in high reputation to the age of St Jerome, as appears from the following passage: "Hierophantæ quoque Atheniensium legant usque hodie cicutæ sorbitione castrari." The emperor Valentinianus intended to have supressed them; but Zozimus * informs us, that he was diverted from his design by the proconsul of Greece. At length Theodosius the elder, by an imperial edict, prohibited the celebration of these as well as of all the other sacra of Paganism. These mysteries, instituted in the reign of Erechtheus, maintained their ground to the period just mentioned, that is, near 2000 years; during which space, the celebration of them never had been interrupted but once. When Alexander the Great massacred the Thebans and razed their city, the Athenians were so much affected with this melancholy event, that they neglected the celebration of that festival.

* *Adversus Jovin.*

83 Abolished by the emperor Theodosius.

There were almost numberless other mysterious institutions among the ancient Pagans, of which these sketched above were the most celebrated. The Samothracian mysteries, instituted in honour of the Cabiri, were likewise of considerable celebrity, and were supposed to confer much the same blessings with the Eleusinian, but were not of equal celebrity. The Cabiri were Phœnician and likewise Egyptian † deities. The learned Bochart has explained their origin, number, names, and some part of their worship. The Orphic mysteries were likewise famous among the Thracians. Orpheus learned them in Egypt, and they were nearly the same with the sacra Bacchanalia of the Greeks. There were likewise the mysteries of

84 Other mysteries among the Pagans of less celebrity.

† *Sanchoniathon* and *Herodotus.*

of Jupiter Idæus in great request among the Cretans, those of the Magna Mater or Cybele, celebrated in Phrygia. To enumerate and detail all these would require a complete volume. We hope our readers will be fully satisfied with the specimen exhibited above. We are convinced many things have been omitted which might have been inserted, but we have collected the most curious and the most important.—Every one of the positions might have been authenticated by quotations from authors of the most undoubted credibility, but that process would have swelled the article beyond all proportion.

M Y S

M Y T

Mystical, Mystics.

MYSTICAL, something mysterious or allegorical. Some of the commentators on the sacred writings, besides a literal find also a mystical meaning. The sense of Scripture, say they, is either that immediately signified by the words and expressions in the common use of language; or it is mediate, sublime, typical, and mystical. The literal sense they again divide into proper literal, which is contained in the words taken simply and properly; and metaphorical literal, where the words are to be taken in a figurative and metaphorical sense. The mystical sense of scripture they divide into three kinds: the first corresponding to faith, and called *allegorical;* the second to hope, called *anagogical;* and the third to charity, called the *tropological sense.* And sometimes they take the same word in Scripture in all the four senses; thus the word *Jerusalem* literally signifies the capital of Judea: allegorically, the church militant: tropologically, a believer: and anagogically, heaven. So, that passage in Genesis, *let there be light, and there was light*, literally signifies corporeal light; by an allegory, the Messiah; in the tropological sense, grace; and anagogically, beatitude, or the light of glory.

MYSTICS, *mystici*, a kind of religious sect, distinguished by their professing pure, sublime, and perfect devotion, with an entire disinterested love of God, free from all selfish considerations.

The mystics, to excuse their fanatic ecstasies and amorous extravagancies, allege that passage of St Paul, *The Spirit prays in us by sighs and groans that are unutterable.* Now, if the spirit, say they, pray in us, we must resign ourselves to its motions, and be swayed and guided by its impulse, by remaining in a state of mere inaction.

Passive contemplation is that state of perfection to which the mystics all aspire.

The authors of this mystic science which, sprung up towards the close of the third century, are not known; but the principles from which it was formed are manifest. Its first promoters proceeded from the known doctrine of the Platonic school, which was also adopted by Origen and his disciples, that the divine nature was infused through all human souls, or that the faculty of reason, from which proceed the health and vigour of the mind, was an emanation from God into the human soul, and comprehended in it the principles and elements of all truth, human and divine. They denied that men could by labour or study excite this celestial flame in their breasts; and therefore they disapproved highly of the attempts of those, who by definitions, abstract theorems, and profound speculations, endeavoured to form distinct notions of truth, and to discover its hidden nature. On the contrary, they maintained that silence, tranquillity, repose, and solitude, accompanied with such acts as might tend to extenuate and exhaust the body, were the means by which the hidden and internal word was excited to produce its latent virtues, and to instruct men in the knowledge of divine things. For thus they reasoned; those who behold with a noble contempt all human affairs, who turn away their eyes from terrestrial vanities, and shut all the avenues of the outward senses against the contagious influences of a material world, must necessarily return to God, when the spirit is thus disengaged from the impediments that prevented that happy union. And in this blessed frame they not only enjoy inexpressible raptures from their communion with the Supreme Being, but also are invested with the inestimable privilege of contemplating truth undisguised and uncorrupted in its native purity, while others behold it in a vitiated and delusive form. Mystics ‖ Mytelene.

The number of the mystics increased in the fourth century, under the influence of the Grecian fanatic, who gave himself out for Dionysius the Areopagite, disciple of St Paul, and probably lived about this period; and by pretending to higher degrees of perfection than other Christians, and practising greater austerity, their cause gained ground, especially in the eastern provinces, in the fifth century. A copy of the pretended works of Dionysius was sent by Balhus to Lewis the Meek, in the year 824, which kindled the holy flame of mysticism in the western provinces, and filled the Latins with the most enthusiastic admiration of this new religion.

In the twelfth century, these mystics took the lead in their method of expounding Scripture; and by searching for mysteries and hidden meaning in the plainest expressions, forced the word of God into a conformity with their visionary doctrines, their enthusiastic feelings, and the system of discipline which they had drawn from the excursions of their irregular fancies. In the thirteenth century, they were the most formidable antagonists of the schoolmen; and towards the close of the fourteenth, many of them resided and propagated their tenets almost in every part of Europe. They had, in the fifteenth century, many persons of distinguished merit in their number: and in the sixteenth century, previous to the Reformation, if any sparks of real piety subsisted under the despotic empire of superstition, they were only to be found among the mystics.

The principles of this sect were adopted by those called *Quietists* in the seventeenth century, and, under different modifications, by the Quakers and Methodists.

MYSTRUM, a liquid measure among the ancients, containing the fourth part of the cyathus, and weighing two drachms and a half of oil, or two drachms two scruples of water or wine. It nearly answers to our spoonful.

MYTELENE. See METYLENE.

MYTHOLOGY

Definition. IS a term compounded of two Greek words, and in its original import it signifies any kind of fabulous doctrine: In its more appropriated sense, it means those fabulous details concerning the objects of worship which were invented and propagated by men who lived in the early ages of the world, and by them transmitted to succeeding generations, either by written records or by oral tradition.

As the theology and mythology of the ancients are almost inseparably connected, it will be impossible for us to develope the latter, without often introducing some observations relating to the former. We must therefore entreat the indulgence of our readers, if upon many occasions we would hazard a few strictures on the names, characters, adventures, and functions of such Pagan divinities as may have furnished materials for those fabulous narrations which the nature of the subject may lead us to discuss.

2 Origin of fable. With respect to *fable*, it may be observed in general, that it is a creature of the human imagination, and derives its birth from that love of the *marvellous* which is in a manner congenial to the soul of man.—The appearances of nature which every day occur, objects, actions, and events, which succeed each other by a kind of routine, are too familiar, too obvious, and uninteresting, either to gratify curiosity or to excite admiration. On the other hand, when the most common phenomena in nature or life are new-modelled by the plastic power of a warm imagination; when they are diversified, compounded, embellished; or even arranged and moulded into forms which seldom or perhaps never occur in the ordinary course of things;—novelty generates admiration, a passion always attended with delightful sensations. Here then we imagine we have discovered the very source of *fiction* and *fable*.—They originated from that powerful propensity in our nature towards the *new* and *surprising*, animated by the delight with which the contemplation of them is generally attended.

Many circumstances contributed to extend and establish the empire of fable. The legislator laid hold on this bias of human nature, and of course employed *fable* and *fiction* as the most effectual means to civilize a rude, unpolished world. The philosopher, the theologist, the poet, the musician, each in his turn, made use of this vehicle to convey his maxims and instructions to the savage tribes. They knew that *truth*, simple and unadorned, is not possessed of charms powerful enough to captivate the heart of man in his present corrupt and degenerate state. This consideration, which did indeed result from the character of their audience, naturally led them to employ fiction and allegory. From this was derived the allegorical taste of the ancients, and especially of the primary sages of the east.

Though almost every nation on the face of the globe, however remote from the centre of population, however savage and averse from cultivation, has fabricated and adopted its own system of mythology; the Orientals, however, have distinguished themselves in a peculiar manner, by the boldness, the inconsistency, and the extravagance of their mythology. The genial warmth of those happy climes, the fertility of the soil, which afforded every necessary, every conveniency, and often every luxury of life, without depressing their spirits by laborious exertions; the face of nature perpetually blooming around them, the skies smiling with uninterrupted serenity; all contributed to inspire the Orientals with a glow of fancy and a vigour of imagination rarely to be met with in less happy regions. Hence every object was swelled beyond its natural dimensions. Nothing was great or little in moderation, but every sentiment was heightened with incredible hyperbole. The magnificent, the sublime, the vast, the enormous, the marvellous, first sprung up, and were brought to maturity, in those native regions of fable and fairy land. As nature, in the ordinary course of her operations, exhibited neither objects nor effects adequate to the extent of their romantic imaginations, they naturally deviated into the fields of fiction and fable. Of consequence, the custom of detailing fabulous adventures originated in the east, and was from thence transplanted into the western countries.

3 Boldness of the oriental mythology.

As the allegorical taste of the eastern nations had sprung from their propensity to fable, and as that propensity had in its turn originated from the love of the marvellous; so did allegory in process of time contribute its influence towards multiplying fables and fiction almost *in infinitum*. The latent import of the allegorical doctrines being in a few ages lost and obliterated, what was originally a moral or theological tenet, assumed the air and habit of a personal adventure.

4 Propensity to personification a source of eastern mythology. The propensity towards personification, almost universal among the orientals, was another fruitful source of fable and allegory. That the people of the east were strongly inclined to personify inanimate objects and abstract ideas, we imagine will be readily granted, when it is considered, that in the formation of language they have generally annexed the affection of sex to those objects. Hence the distinction of grammatical genders, which is known to have originated in the eastern parts of the world. The practice of personifying virtues, vices, religious and moral affections, was necessary to support that allegorical style which universally prevailed in those countries. This mode of writing was in high reputation even in Europe some centuries ago; and to it we are indebted for some of the most noble poetical compositions now extant in our own language. Those productions, however, are but faint imitations of the original mode of writing still current among the eastern nations. The Europeans derived this species of composition from the Moorish inhabitants of Spain, who imported it from Arabia, their original country.

5 The effects of hieroglyphic writing on mythology. The general use of hieroglyphics in the east, must have contributed largely towards extending the empire of mythology. As the import of the figures employed in this method of delineating the signs of ideas was in a great measure arbitrary, mistakes must have

have been frequently committed in ascertaining the notions which they were at the first intended to represent. When the developement of these arbitrary signs happened to be attended with uncommon difficulty, the expounders were obliged to have recourse to conjecture. Those conjectural expositions were for the most part tinctured with that bias towards the marvellous which universally prevailed among the primitive men. This we find is the case even at this day, when moderns attempt to develope the purport of emblematical figures, preserved on ancient medals, entaglions, &c.

The wise men of the east delighted in obscure enigmatical sentences. They seem to have disdained every sentiment obvious to vulgar apprehension. The words of the wise, and their dark sayings, often occur in the most ancient records both sacred and profane. The sages of antiquity used to vie with each other for the prize of superior wisdom, by propounding riddles, and dark and mysterious questions, as subjects of investigation. The contest between Solomon and Hiram, and that between Amasis king of Egypt and Polycrates tyrant of Samos, are universally known.—As the import of those enigmatical propositions was often absolutely lost, in ages when the art of writing was little known, and still less practised, nothing remained but fancy and conjecture, which always verged towards the regions of fable. This then, we think, was another source of mythology.

6 Mythology reduced to a kind of system in Egypt.

The Pagan priests, especially in Egypt, were probably the first who reduced mythology to a kind of system. The sacerdotal tribe, among that people, were the grand depositories of learning as well as of religion. That order of men monopolized all the arts and sciences. They seem to have formed a conspiracy among themselves, to preclude the laity from all the avenues of intellectual improvement. This plan was adopted with a view to keep the laity in subjection, and to enhance their own importance. To accomplish this end, they contrived to perform all the ministrations of their religion in an unknown tongue, and to cover them with a thick veil of fable and allegory. The language of Ethiopia became their sacred dialect, and hieroglyphics their sacred character.—Egypt, of course, became a kind of fairy land, where all was jugglery, magic, and enchantment. The initiated alone were admitted to the knowledge of the occult mystical exhibitions, which, in their hands, constituted the essence of their religion. From these the vulgar and profane were prohibited by the most rigorous penalties (see MYSTERIES). The Egyptians, and indeed all the ancients without exception, deemed the mysteries of religion too sacred and solemn to be communicated to the herd of mankind, naked and unreserved; a mode by which they imagined those sacred and sublime oracles would have been defiled and degraded. "Procul, ô procul este profani—Odi profanum vulgus et arceo." Egypt was the land of graven images; allegory and mythology were the veil which concealed religion from the eyes of the vulgar; fable was the groundwork of that impenetrable covering.

7 In the earliest ages of the world mythology had no existence.

In the earliest and most unpolished stage of society we cannot suppose fable to have existed among men. Fables are always *tales of other times*, but at this period other times did not reach far enough backward to afford those fruits of the imagination sufficient time to arrive at maturity. Fable requires a considerable space of time to acquire credibility, and to rise into reputation. Accordingly, we find that both the Chinese and Egyptians, the two most ancient nations whose annals have reached our times, were altogether unacquainted with fabulous details in the most early and least improved periods of their respective monarchies. It has been shown almost to a demonstration, by a variety of learned men, that both the one and the other people, during some centuries after the general deluge, retained and practised the primitive Noachic religion, in which fable and fancy could find no place; all was genuine unsophisticated truth.

As soon as the authentic tradition concerning the origin of the universe was either in a good measure lost, or at least adulterated by the invention of men, fable and fiction began to prevail. The Egyptian *Thoth* or Thyoth, or Mercury Trismegistus, and Mochus the Phœnician, undertook to account for the formation and arrangement of the universe, upon principles purely mechanical. Here fable began to usurp the place of genuine historical truth. Accordingly, we find that all the historians of antiquity, who have undertaken to give a general detail of the affairs of the world, have ushered in their narration with a fabulous cosmogony. Here imagination ranged unconfined over the boundless extent of the primary chaos. To be convinced of the truth of this assertion, we need only look into Sanchoniathon's Cosmogony, Euseb. Præp. Evang. l. 1. sub init. and Diodorus Sic. l. 1. From this we suppose it will follow, that the first race of fables owed their birth to the erroneous opinions of the formation of the universe.

8 Fabulous cosmogony, the first mythological details.

Having now endeavoured to point out the origin of mythology, or fabulous traditions, we shall proceed to lay before our readers a brief detail of the mythology of the most respectable nations of antiquity, following the natural order of their situation.

9 Chinese mythology.

The Chinese, if any credit be due to their own annals, or to the missionaries of the church of Rome, who pretend to have copied from them, were *the first of the nations*. Their fabulous records reach upwards many myriads of years before the Mosaic era of the creation. The events during that period of time, if any had been recorded, must have been fabulous as the period itself. These, however, are buried in eternal oblivion. The missionaries, who are the only sources of our information with relation to the earliest periods of the Chinese history, represent those people as having retained the religion of Noah many centuries after the foundation of their empire. Upon this supposition, their cosmogony must have been sound and genuine, without the least tincture of those fabulous ingredients which have both disguised and disgraced the cosmogonies of most other nations.

10 Birth and invention of Fohi.

According to the most authentic accounts, *Fohe* or *Fohi* laid the foundation of that empire about 4000 years ago. This emperor, according to the Chinese, was conceived in a miraculous manner. His mother, say they, one day as she was walking in a desert place, was surrounded by a rainbow; and, being impregnated by this meteor, was in due time delivered of that celebrated legislator. This personage, like the Athenian Cecrops, was half a man and half a serpent.

His

His intellectual powers were truly hyperbolical. In one day he discovered 50 different species of poisonous herbs. He taught his countrymen the whole art of agriculture in the space of a very few years. He instructed them how to sow five different sorts of grain. He invented boats, and nets for fishing, the art of fabricating porcelain, the management of silk worms, the manufacturing of silk, &c. In a word, that wonderful personage was inspired by Heaven with knowledge, which qualified him for composing that incomparable body of laws which are even at this day the wonder of the world. Our readers will admit, that this whole detail is fabulous and chimerical. The most learned part of them will readily observe, that the Chinese in ascribing the invention of all the useful arts to their Fohi, are perfectly agreed with almost all the other nations of antiquity. The Indians ascribe every invention to *Budha*, or *Vishnou*, or *Foe;* the Persians to *Zerdusht*, or *Zoroaster;* the Chaldeans to their man of the sea, whom they call *Oannes;* the Egyptians to *Thoth* or *Thyoth;* the Phœnicians to *Melicerta;* the Greeks to the family of the *Titans;* and the Scandinavians to *Odin*, &c.

11 Miraculous birth of Confucius.

About 551 years before the Christian era, appeared the famous Chinese philosopher *Con-fu-tse* or Confucius. Concerning the birth of this prince of philosophers, the Chinese have propagated the following legendary tale. His mother, walking in a solitary place, was impregnated by the vivifying influence of the heavens. The babe, thus produced, spake and reasoned as soon as it was born. Confucius, however, wrought no miracles, performed no romantic exploits, but lived an austere ascetic life, taught and inculcated the doctrines of pure morality, and died, remarkable only for superior wisdom, religious, moral, and political.

12 Lao-kiun and his doctrines.

About the year of Christ 601, flourished the sectary *Lao-kiun*. His mother carried him 30 years in her womb, and was at last delivered of him under a plum-tree. This philosopher was the Epicurus of the Chinese. His disciples, who were denominated *Tao-sse*, i. e. heavenly doctors, were the first who corrupted the religion of the Chinese. They were addicted to magic, and introduced the worship of good and bad demons. Their doctrine was embraced by a long succession of emperors. One of these princes, called *You-ti*, had been deprived by death of a favourite mistress, whom he loved with the most extravagant passion. The emperor, by the magical skill of one of these doctors, obtained an interview with his deceased mistress, a circumstance which rivetted the whole order in the affection and esteem of the deluded prince. Here our readers will observe the exact counterpart of the fable of Eurydice, so famous in the mythology of the Greeks and Romans. That such a system of religious principles must have abounded with mythological adventures is highly probable; but as the missionaries, to whom we are chiefly indebted for our information relating to the religion of the Chinese, have not taken the pains to record them, we find it impossible to gratify the curiosity of our readers on that head.

13 Introduction of the worship of *Fo*, and of the doctrine of the metempsychosis into China.

The worship of the idol Fo, or Foe, was transplanted from India into China about the 56th year of the Christian era, upon the following occasion. One of the doctors of the Tao-sse had promised a prince of the family of Tchou, and brother of the emperor Ming-ti, to make him enter into communion with the spirits. At his solicitation an ambassador was despatched into India, in order to inquire where the true religion was to be found. There had been a tradition, say the missionaries, ever since the age of Confucius, that the true religion was to be found in the west.—The ambassador stopt short in India; and finding that the god Foe was in high reputation in that country, he collected several images of that deity painted on chintz, and with it 42 chapters of the canonical books of the Hindoos, which, together with the images, he laid on a white elephant, and transported into his native country. At the same time he imported from the same quarter the doctrine of the transmigration of souls, which is firmly believed in China to this day. The doctrine and worship of Foe, thus introduced, made a most rapid progress all over China, Japan, Siam, &c. The priests of Foe are called among the Siamese *Talapoins;* by the Tartars, *Lamas;* by the Chinese, *Ha-chang;* and by the people of Japan, *Bonzes*. By this last appellation they are generally known in Europe.

14 The worshippers of Foe great mythologists.

An infinitude of fables was invented and propagated by the disciples of Foe, concerning the life and adventures of their master. If the earlier ages of the Chinese history are barren of mythological incidents, the later periods, after the introduction of the worship of Foe, furnish an inexhaustible store of miracles, monsters, fables, intrigue, exploits, and adventures, of the most villanous complexion. Indeed, most of them are so absurd, so ridiculous, and at the same time so impious and profane, that we are convinced our readers will easily dispense with a detail from which they could reap neither entertainment nor instruction. Such as may find themselves disposed to rake into this abominable puddle, we must refer to the reverend fathers Du Halde, Couplet, Amiot, Kircher, and other members of the propaganda, in whose writings they will find wherewithal to satisfy, and even to surfeit, their appetite.

15 Hindoo mythology.

The Hindoos, like the other nations of the east, for a long time retained the worship of the true God. At length, however, idolatry broke in, and, like an impetuous torrent, overwhelmed the country. First of all, the genuine history of the origin of the universe was either utterly lost, or disguised under a variety of fictions and allegories. We are told that *Brimha*, the supreme divinity of the Hindoos, after three several efforts, at last succeeded in creating four persons, whom he appointed to rule over all the inferior creatures.—Afterwards Brimha joined his efficient power with Bishon and Rulder; and by their united exertions they produced ten men, whose general appellation is *Munies*, that is, the inspired. The same being, according to another mythology, produced four other persons, as imaginary as the former; one from his breast, one from his back, one from his lip, and one from his heart. These children were denominated *Bangs;* the import of which word we cannot pretend to determine. According to another tradition, Brimha produced the Bramins from his mouth, to pray, to read, to instruct; the Chiltern from his arms, to draw the bow, to fight, to govern; the Bice from his belly or thighs, to nourish, to provide the necessaries of life by agriculture and commerce; the Seder from his feet, for subjection,

subjection, to serve, to labour, to travel. The reader will see at once, in these allegorical persons, the four casts or septs into which the Hindoo nations have, time immemorial, been divided. These are some of their most celebrated mythological traditions with relation to the origin of the universe.

16 Hindoo traditions relating to the deluge, &c.

The Hindoos have likewise some mythological opinions which seem to relate to the general deluge. They tell us, that desiring the preservation of herds and of brahmans, of genii and of virtuous men, of *vedas* of law, and of precious things, the Lord of the universe assumes many bodily shapes; but though he pervades, like the air, a variety of beings, yet he is himself unvaried, since he has no quality in him subject to change. At the close of the last *calpa*, there was a general destruction, occasioned by the sleep of Brahme, whence his creatures in different worlds were drowned in a vast ocean. Brahme being inclined to slumber after a lapse of so many ages, the strong demon *Hyagri-va*, came near him, and stole the *vedas* which had flowed from his lips. When *Heri*, the preserver of the universe, discovered this deed of the prince of *Dainavas*, he took the shape of a minute fish called *Sap-hari*. After various transformations, and an enormous increase of size in each of them, the Lord of the universe loving the righteous man (A), who had still adhered to him under all these various shapes, and intending to preserve him from the sea of destruction caused by the depravity of the age, thus told him how he was to act: "In seven days from the present time, O thou tamer of enemies! the three worlds will be plunged in an ocean of death; but in the midst of the destroying waves a large vessel sent by me for thy use shall stand before thee." The remaining part of the mythology so nearly resembles the Mosaic history of Noah and the general deluge, that the former may be a strong confirmation of the truth of the latter. To dry up the waters of the deluge, the power of the Deity descends in the form of a *boar*, the symbol of strength, to draw up and support on his tusks the whole earth, which had been sunk beneath the ocean. Again, The same power is represented as a tortoise sustaining the globe, which had been convulsed by the violent assaults of demons, while the gods charmed the sea with the mountain *Mandar*, and forced it to disgorge the sacred things and animals, together with the water of life which it had swallowed. All these stories, we think, relate to the same event, shadowed by a moral, a metaphysical, and an astronomical allegory; and all three seem connected with the hieroglyphical sculptures of the old Egyptians.

The Hindoos divide the duration of the world into four *yugs* or *jugs*, or *jogues*, each consisting of a prodigious number of years. In each of those periods, the age and stature of the human race have been gradually diminished; and in each of them mankind has gradually declined in virtue and piety, as well as in age and stature. The present period they call the *Collæ*, i. e. the corrupt jogue, which they say is to last 400,000 years, of which near 5000 years are already past. In the last part of the preceding jogue, which they call the *dwa paar*, the age of man was contracted into 1000 years, as in the present it is confined to 100. From this proportional diminution of the length of the human life, our readers will probably infer, that the two last jogues bear a pretty near resemblance to the Mosaic history of the age of the antediluvian and postdiluvian patriarchs; and that the two first are imaginary periods prior to the creation of the world, like those of the Chinese, Chaldeans, and Egyptians.

17 The world subject to various dissolutions and resuscitations.

According to the mythology of the Hindoos, the system of the world is subject to various dissolutions and resuscitations. At the conclusion of the Collæ jogue, say they, a grand revolution will take place, when the solar system will be consumed by fire, and all the elements reduced to their original constituent atoms. Upon the back of these revolutions, Brimha, the supreme deity of the Hindoos, is sometimes represented as a new born infant, with his toe in his mouth, floating on a camala or water flower, sometimes only on a leaf of that plant, on the surface of the vast abyss. At other times he is figured as coming forth of a winding shell: and again as blowing up the mundane foam with a pipe at his mouth. Some of these emblematical figures and attitudes, our learned readers will probably observe, nearly resemble those of the ancient Egyptians.

But the vulgar religion of the ancient Hindoos was of a very different complexion, and opens a large field of mythological adventures. We have observed above, that the Fo or Foe of the Chinese was imported from India; and now we shall give a brief detail of the mythological origin of that divinity. We have no certain account of the birth-place of this imaginary deity.— His followers relate, that he was born in one of the kingdoms of India near the line, and that his father was one of that country. His mother brought him into the world by the left side, and expired soon after her delivery. At the time of her conception, she dreamed that she had swallowed a white elephant; a circumstance which is supposed to have given birth to the veneration which the kings of India have always shown for a white animal of that species. As soon as he was born, he had strength enough to stand erect without assistance. He walked abroad at seven, and, pointing with one hand to the heavens, and with the other to the earth, he cried out, "In the heavens, and on the earth, there is no one but me who deserves to be honoured." At the age of 30, he felt himself all on a sudden filled with the divinity; and now he was metamorphosed into Fo or Pagod, according to the expression of the Hindoos. He had no sooner declared himself a divinity, than he thought of propagating his doctrine, and proving his divine mission by miracles. The number of his disciples was immense; and they soon spread his dogmas over all India, and even to the higher extremities of Asia.

18 Birth, &c. of the god Fo.

19 Doctrines of Fo derived from Egypt.

One of the principal doctrines which Fo and his disciples propagated, was the metempsychosis or transmigration of souls. This doctrine, some imagine, has given

(A) He was Sovereign of the world. His name was *Mana*, or Statgavrata; his patronymic name was *Vaisvata*, or Child of the Sun.

given rise to the multitude of idols reverenced in every country where the worship of Fo is established. Quadrupeds, birds, reptiles, and the vilest animals, had temples erected for them; because, say they, the soul of the god, in his numerous transmigrations, may have at one time or other inhabited their bodies.

Both the doctrine of transmigration and of the worship of animals seems, however, to have been imported from Egypt into India. If the intercourse between these two countries was begun at so early a period as some very late writers have endeavoured to prove, such a supposition is by no means improbable. The doctrine of the transmigration of souls was early established among the Egyptians. It was, indeed, the only idea they formed of the soul's immortality. The worship of animals among them seems to have been still more ancient. If such an intercourse did actually exist, we may naturally suppose that colonies of Egyptian priests found their way into India, as they did afterwards into Asia Minor, Italy, and Greece. That colonies of Egyptians did actually penetrate into that country, and settle there, many centuries before the Nativity, is a fact that cannot be called in question, for reasons which the bounds prescribed us in this article will not allow us to enumerate. We shall only observe, that from the hieroglyphical representations of the Egyptian deities seem to have originated those monstrous idols which from time immemorial have been worshipped in India, China, Japan, Siam, and even in the remotest parts of Asiatic Tartary.

20 The incarnations of Vishnou.

Foe is often called *Budha* or *Budda*, and sometimes *Vishnou*; perhaps, indeed, he may be distinguished by many other names, according to the variety of dialects of the different nations among which his worship was established. An infinitude of fables was propagated by his disciples concerning him after his death. They pretended that their master was still alive; that he had been already born 8000 times, and that he had successively appeared under the figure of an ape, a lion, a dragon, an elephant, a boar, &c. These were called the incarnations of Vishnou. At length he was confounded with the supreme God; and all the titles, attributes, operations, perfections, and ensigns of the Most High were ascribed to him. Sometimes he is called Amida, and represented with the head of a dog, and worshipped as the guardian of mankind. He sometimes appears as a princely personage, issuing from the mouth of a fish. At other times, he wears a lunette on his head, in which are seen cities, mountains, towers, trees, in short, all that the world contains. These transformations are evidently the children of allegorical or hieroglyphical emblems, and form an exact counterpart to the symbolical worship of the Egyptians.

The enormous mass of mythological traditions which have in a manner deluged the vast continent of India, would fill many volumes: We have selected the preceding articles as a specimen only, by which our readers may be qualified to judge of the rest. If they find themselves disposed to indulge their curiosity at greater length, we must remit them to Thevenot's and Hamilton's Travels, to Mons. Anquetil in his Zend Avesta, Halhed's Introduction to his Translation of the Code of Gentoo Laws, Col. Dow's History of Hindostan, Grose's Voyage to the East Indies, Asiatic Researches, vol. i. and ii.

21 Persian mythology.

The mythology of the Persians is, if possible, still more extravagant than that of the Hindoos. It supposes the world to have been repeatedly destroyed, and repeopled by creatures of different formation, who were successively annihilated or banished for their disobedience to the supreme Being. The monstrous griffin *Sinergh* tells the hero *Caherman* that she had already lived to see the earth seven times filled with creatures, and seven times a perfect void: that before the creation of Adam, this globe was inhabited by a race of beings called *Peri* and *Dives*, whose characters formed a perfect contrast. The Peri are described as beautiful and benevolent; the Dives as deformed, malevolent, and mischievous, differing from infernal demons only in this, that they are not as yet confined to the pit of hell. They are for ever ranging over the world, to scatter discord and misery among the sons of men. The Peri nearly resemble the fairies of Europe: and perhaps the Dives gave birth to the giants and magicians of the middle ages. The Peri and Dives wage incessant wars; and when the Dives make any of the Peri prisoners, they shut them up in iron cages, and hang them on the highest trees, to expose them to public view, and to the fury of every chilling blast.

22 *Peri* and *Dives*.

When the Peri are in danger of being overpowered by their foes, they solicit the assistance of some mortal hero; which produces a series of mythological adventures highly ornamental to the strains of the Persian bards, and which, at the same time, furnishes an inexhaustible fund of the most diversified machinery.

One of the most celebrated adventurers in the mythology of Persia is *Tahmuras*, one of their most ancient monarchs. This prince performs a variety of exploits, while he endeavours to recover the fairy Merjan. He attacks the Dive Demrush in his own cave; where having vanquished the giant or demon, he finds vast piles of hoarded wealth; these he carries off with the fair captive. The battles, labours, and adventures of Rostan, another Persian worthy, who lived many ages after the former, are celebrated by the Persian bards with the same extravagance of hyperbole with which the labours of Hercules have been sung by the poets of Greece and Rome.

23 Persia the birth place of chivalry and romance.

The adventures of the Persian heroes breathe all the wildness of achievement recorded of the knights of Gothic romance. The doctrine of enchantments, transformations, &c. exhibited in both, is a characteristic symptom of one common original. Persia is the genuine classic ground of eastern mythology, and the source of the ideas of chivalry and romance; from which they were propagated to the regions of Scandinavia, and indeed to the remotest corners of Europe towards the west.

Perhaps our readers may be of our opinion, when we offer it as a conjecture, that the tales of the war of the Peri and Dives originated from a vague tradition concerning good and bad angels: nor is it, in our opinion, improbable, that the fable of the wars between the gods and giants, so famous in the mythology of Greece and Italy, was imported into the former of these countries from the same quarter. For a more particular account of the Persian mythology, our readers may consult Dr

Hyde Relig. vet. Pers. Medor. &c. D'Herbelot's Bibl. Orient. and Mr Richardson's introduction to his Persian and Arabic Dictionary.

24 Chaldean mythology.

The mythology of the Chaldeans, like that of the other nations of the east, commences at a period myriads of years prior to the era of the Mosaic creation. Their cosmogony, exhibited by Berosus, who was a priest of Belus, and deeply versed in the antiquities of his country, is a piece of mythology of the most extravagant nature. It has been copied by Eusebius (Chron. lib. i. p. 5.); it is likewise to be found in Syncellus, copied from Alexander Polyhistor. According to this historian, there were at Babylon written records preserved with the greatest care, comprehending a period of fifteen myriads of years. Those writings likewise contained a history of the heavens and the sea, of the earth, and of the origin of mankind. "In the beginning (says Berosus, copying from Oannes, of whom we shall give a brief account below) there was nothing but darkness and an abyss of water, wherein resided most hideous beings produced from a twofold principle. Men appeared with two wings; some with two and some with four faces. They had one body, but two heads; the one of a man, the other of a woman. Other human figures were to be seen, furnished with the legs and horns of goats. Some had the feet of horses behind, but before were fashioned like men, resembling hippocentaurs." The remaining part of this mythology is much of the same complexion; indeed so extravagant, that we imagine our readers will readily enough dispense with our translating the sequel. "Of all these (says the author) were preserved delineations in the temple of Belus at Babylon. The person who was supposed to preside over them was called *Omorca*. This word, in the Chaldean language, is *Thalath*, which the Greeks call Θαλασσα, but it more properly imports the moon. Matters being in this situation, *their* god (says Eusebius), *the* god (says Syncellus) came and cut the woman asunder; and out of one half of her he formed the earth, and out of the other he made the heavens; and, at the same time, he destroyed the monsters of the abyss." This whole mythology is an allegorical history copied from hieroglyphical representations, the real purport of which could not be decyphered by the author. Such, in general, were the consequences of the hieroglyphical style of writing.

25 Oannes the legislator of the Chaldeans.

Oannes, the great civilizer and legislator of the Chaldeans, according to Apollodorus, who copied from Berosus, was an amphibious animal of a heterogeneous appearance. He was endowed with reason and a very uncommon acuteness of parts. His whole body resembled a fish. Under the head of a fish he had also another head, and feet below similar to those of a man, which were subjoined to the tail of the fish. His voice and language were articulate and perfectly intelligible, and there was a figure of him still extant in the days of Berosus. He made his appearance in the Erythrean or Red sea, where it borders upon Babylonia. This monstrous being conversed with men by day; but at night he plunged into the sea, and remained concealed in the water till next morning. He taught the Babylonians the use of letters, and the knowledge of all the arts and sciences. He instructed them in the method of building houses, constructing temples, and all other edifices. He taught them to compile laws and religious ceremonies, and explained to them the principles of mathematics, geometry, and astronomy. In a word he communicated to them every thing necessary, useful, and ornamental: and so universal were his instructions, that not one single article had ever been added to them since the time they were first communicated. Helladius is of opinion that this strange personage, whoever he was, came to be represented under the figure of a fish, not because he was actually believed to be such, but because he was clothed with the skin of a seal. By this account our readers will see that the Babylonian Oannes is the exact counterpart of the Fohi of the Chinese, and the Thyoth or the Mercury Trismegistus of the Egyptians. It is likewise apparent that the idea of the monster compounded of the man and the fish has originated from some hieroglyphic of that form grafted upon the appearance of man. Some modern mythologists have been of opinion, that Oannes was actually Noah the great preacher of righteousness; who, as some think, settled in Shinar or Chaldea after the deluge, and who, in consequence of his connexion with that event, might be properly represented under the emblem of *the Man of the Sea*.

26 The nativity of the goddess of beauty and love.

The nativity of Venus, the goddess of beauty and love, is another piece of mythology famous among the Babylonians and Assyrians. An egg, say they, of a prodigious size, dropt from heaven into the river Euphrates. Some doves settled upon this egg, after that the fishes had rolled it to the bank. In a short time this egg produced Venus, who was afterwards called *Dea Syria*, the Syrian goddess. In consequence of this tradition (says Hyginus), pigeons and fishes became sacred to this goddess among the Syrians, who always abstained from eating the one or the other. Of this imaginary being we have a very exact and entertaining history in the treatise *De Dea Syria*, generally ascribed to Lucian.

In this mythological tradition our readers will probably discover an allusion to the celebrated *Mundane egg*; and at the same time the story of the fishes will lead them to anticipate the connexion between the sea and the moon. This same deity was the Atargatis of Ascalon, described by Diodorus the Sicilian; the one half of her body a woman and the other a fish. This was no doubt a hieroglyphic figure of the moon, importing the influence of that planet upon the sea and the sex. The oriental name of this deity evidently points to the moon; for it is compounded of two Hebrew words (B), which import "the queen of the host of heaven."

27 The fable of Semiramis.

The fable of Semiramis is nearly connected with the preceding one. Diodorus Siculus has preserved the mythological history of this deity, which he and all the writers of antiquity have confounded with the Babylonian princess of the same name. That historian informs us, that the word *Semiramis*, in the Syrian dialect, signifies "a wild pigeon;" but we apprehend that this term was a name or epithet of the moon,

(B) *Adar* or *Hadar*, "*magnificus*;" and *Gad*, "*exercitus turmi*."

moon, as it is compounded of two words (c) of an import naturally applicable to the lunar planet. It was a general practice among the Orientals to denominate their sacred animals from that deity to which they were consecrated. Hence the moon being called *Semiramis*, and the pigeon being sacred to her divinity, the latter was called by the name of the former.

As the bounds prescribed this article render it impossible for us to do justice to this interesting piece of mythology, we must beg leave to refer our readers for farther information to Diod. Sic. lib. ii. Hyginus Poet. Astron. Fab. 197. Pharnutus de Nat. Deor. Ovid. Metam. lib. iv. Athen. in Apol. Izetzes, Chil. ix. cap. 275. Seld. de Diis Syr. Syrit. ii. p. 183.

28 Little known of Arabian mythology

We should now proceed to the mythology of the Arabians, the far greatest part of which is, however, buried in the abyss of ages; though, when we reflect on the genius and character of that people, we must be convinced that they too, as well as the other nations of the east abounded in fabulous relations and romantic compositions. The natives of that country have always been enthusiastically addicted to poetry, of which fable is the essence. Wherever the Muses have erected their throne, fables and miracles have always appeared in their train. In the Koran we meet with frequent allusions to well-known traditionary fables. These had been transmitted from generation to generation by the bards and rhapsodists for the entertainment of the vulgar. In Arabia, from the earliest ages, it has always been one of the favourite entertainments of the common people, to assemble in the serene evenings around their tents, or on the platforms with which their houses are generally covered, or in large halls erected for the purpose, in order to amuse themselves with traditional narrations of the most distinguished actions of their most remote ancestors. Oriental imagery always embellished their romantic details. The glow of fancy, the love of the marvellous, the propensity towards the hyperbolical and the vast, which constitute the essence of oriental description, must ever have drawn the relation aside into the devious regions of fiction and fairy land. The religion of Mahomet beat down the original fabric of idolatry and mythology together. The Arabian fables current in modern times are borrowed or imitated from Persian compositions; Persia being still the grand nursery of romance in the east.

29 Egyptian mythology.

In Egypt we find idolatry, theology, and mythology, almost inseparably blended together. The inhabitants of this region, to, as well as of others in the vicinity of the centre of population, adhered for several centuries to the worship of the true God. At last, however, conscious of their own ignorance, impurity, imperfection, and total unfitness to approach an infinitely perfect Being, distant, as they imagined, and invisible, they began to cast about for some beings more exalted, and more perfect than themselves, by whose mediation they might prefer their prayers to the supreme Majesty of heaven. The luminaries of heaven, which they imagined were animated bodies, naturally presented themselves. These were splendid and glorious beings. They were thought to partake of the divine nature: they were revered as the satraps, prefects, and representatives of the supreme Lord of the universe. They were visible, they were beneficent; they dwelt nearer to the gods, they were near at hand and always accessible. These were, of course, employed as mediators and intercessors between the supreme Divinity and his humble subjects of this lower world. Thus employed, they might claim a subordinate share of worship, which was accordingly assigned them. In process of time, however, that worship, which was originally addressed to the supreme Creator by the mediation of the heavenly bodies, was in a great measure forgotten, and the adoration of mankind ultimately terminated on those illustrious creatures. To this circumstance, we think, we may ascribe the origin of that species of idolatry called *Zabiism*, or the worship of the host of heaven, which overspread the world early and almost universally. In Egypt this mode of worship was adopted in all its most absurd and most enthusiastic forms: and at the same time the most heterogeneous mythology appeared in its train. The mythology of the ancient Egyptians was so various and multiform, so complicated and so mysterious, that it would require many volumes even to give a superficial account of its origin and progress, not only in its mother country, but even in many other parts of the eastern and western world. Besides, the idolatry and mythology of that wonderful country are so closely connected and so inseparably blended together, that it is impossible to describe the latter without at the same time developing the former. We hope, therefore, our readers will not be disappointed, if, in a work of this nature, we touch only upon some of the leading or most interesting articles of this complicated subject.

30 Origin of Zabiism.

31 Reign of gods and demigods, &c. in Egypt.

The Egyptians confounded the revolutions of the heavenly bodies with the reigns of their most early monarchs. Hence the incredible number of years included in the reign of their eight superior gods, who, according to them, filled the Egyptian throne successively in the most early periods of time. To these, according to their system, succeeded twelve demigods, who likewise reigned an amazing number of years. These imaginary reigns were no other than the periodical revolutions of the heavenly bodies preserved in their almanacks, which might be carried back, and actually were carried back, at pleasure. Hence the fabulous antiquity of that kingdom. The imaginary exploits and adventures of these gods and demigods furnished an inexhaustible fund of mythological romances. To the demigods succeeded the kings of the cynic cycle, personages equally chimerical with the former. The import of this epithet has greatly perplexed critics and etymologists. We apprehend it is an oriental word importing *royal* dignity, elevation of rank. This appellation intimated, that the monarchs of that cycle, admitting that they actually existed, were more powerful and more highly revered than their successors. After the princes of the cynic cycle comes another race, denominated *Nekyes*, a title likewise implying royal, splendid, glorious. These cycles

(c) *Shem* or *Sem*, "a sign," and *ramah*, "high."

cycles figure high in the mythological annals of the Egyptians, and have furnished materials for a variety of learned and ingenious disquisitions. The wars and adventures of Osiris, Oris, Typhon, and other allegorical personages who figure in the Egyptian rubric; the wanderings of Isis, the sister and wife of Osiris; the transformation of the gods into divers kinds of animals; their birth, education, peregrinations, and exploits;—compose a body of mythological fictions so various, so complicated, so ridiculous, and often so apparently absurd, that all attempts to develope and explain them have hitherto proved unsuccessful. All, or the greatest part, of those extravagant fables, are the offspring of hieroglyphical or allegorical emblems devised by the priests and sages of that nation, with a view to conceal the mysteries of their religion from that class of men whom they stigmatized with the name of the uninitiated rabble.

32 Birth, exploits, and transformation of the gods.

33 Worship of brute animals, &c.

The worship of brute animals and of certain vegetables, universal among the Egyptians, was another exuberant source of mythological adventures. The Egyptian priests, many of whom were likewise profound philosophers, observed, or pretended to observe, a kind of analogy between the qualities of certain animals and vegetables, and those of some of their subordinate divinities. Such animals and vegetables they adopted, and consecrated to the deities to whom they were supposed to bear this analogical resemblance; and in process of time they considered them as the visible emblems of those divinities to which they were consecrated. By these the vulgar addressed their archetypes: in the same manner, as in other countries, pictures and statues were employed for the very same purpose. The mob, in process of time, forgetting the emblematical character of those brutes and vegetables, addressed their devotion immediately to them; and of course these became the ultimate objects of vulgar adoration.

After that these objects, animate or inanimate, were consecrated as the visible symbols of the deities, it soon became fashionable to make use of their figures to represent those deities to which they were consecrated. This practice was the natural consequence of the hieroglyphical style which universally prevailed among the ancient Egyptians. Hence Jupiter Ammon was represented under the figure of a ram, Apis, under that of a cow, Osiris of a bull, Pan of a goat, Thoth or Mercury of an ibis, Bubastis or Diana of a cat, &c. It was likewise a common practice among those deluded people to dignify these objects, by giving them the names of those deities which they represented. By this mode of dignifying these sacred emblems, the veneration of the rabble was considerably enhanced, and the ardour of their devotion inflamed in proportion. From these two sources, we think, are derived the fabulous transformation of the gods, so generally celebrated in the Egyptian mythology, and from it imported into Greece and Italy. In consequence of this practice, their mythological system was rendered at once enormous and unintelligible.

34 Mercury Trismegistus the author of the Egyptian mythology.

Their Thoth, or Mercury Trismegistus, was, in our opinion, the inventor of this unhappy system. This personage, according to the Egyptians, was the original author of letters, geometry, astronomy, music, architecture; in a word, of all the elegant and useful arts, and of all the branches of science and philosophy. He it was who first discovered the analogy between the divine affections, influences, appearances, operations, and the corresponding properties, qualities, and instincts of certain animals, and the propriety of dedicating particular kinds of vegetables to the service of particular deities.

The priests, whose province it was to expound the mysteries of that allegorical hieroglyphical religion, (see MYSTERIES), gradually lost all knowledge of the primary import of the symbolical characters. To supply this defect, and at the same time to veil their own ignorance, the sacerdotal instructors had recourse to fable and fiction. They heaped fable upon fable, till their religion became an accumulated chaos of mythological absurdities.

Two of the most learned and most acute of the ancient philosophers have attempted a rational explication of the latent import of the Egyptian mythology; but both have failed in the attempt; nor have the moderns, who have laboured in the same department, performed their part with much better success. Instead, therefore, of prosecuting this inexplicable subject, which would swell this article beyond all proportion, we must beg leave to refer those who are desirous of further information to the following authors, where they will find enough to gratify their curiosity, if not to inform their judgment: Herodotus, lib. ii. Diodorus Siculus, lib. i. Plut. Isis et Osiris; Jamblichus de Myst. Egypt. Horapollo Hieroglyph. Egypt. Macrob. Sat. cap. 23. among the ancients; and among the moderns, Kircher's Oedip. Voss. de Orig. et Prog. Idol. Mr Bryant's Analysis of Anc. Mythol. Mons. Gebelin Monde Prim.; and above all, to the learned Jablonski's Panth. Egyptiorum.

35 Phœnician mythology.

The elements of Phœnician mythology have been preserved by Eusebius, Præp. Evang. sub. init. In the large extract which that learned father had copied from Philo Biblius's translation of Sanchoniathon's History of Phœnicia, we are furnished with several articles of mythology. Some of these throw considerable light on several passages of the sacred history; and all of them are strictly connected with the mythology of the Greeks and Romans. There we have preserved a brief but entertaining detail of the fabulous adventures of Uranus, Cronus, Dagon, Thyoth or Mercury, probably the same with the Egyptian hero of that name. Here we find Muth or Pluto, Æpheestus or Vulcan, Æsculapius, Nereus, Poseedon or Neptune, &c. Astarte, or Venus Urania, makes a conspicuous figure in the catalogue of Phœnician worthies; Pallas or Minerva is planted on the territory of Attica; in a word, all the branches of the family of the Titans, who in after ages figured in the rubric of the Greeks, are brought upon the stage, and their exploits and adventures briefly detailed.

36 Grecian mythology derived from Egypt and Phœnicia:

By comparing this fragment with the mythology of the Atlantidæ and that of the Cretans preserved by Diodorus the Sicilian, lib. v. we think there is good reason to conclude, that the family of the Titans, the several branches of which seem to have been both the authors and objects of a great part of the Grecian idolatry, originally emigrated from Phœnicia. This conjecture will receive additional strength, when it is considered, that almost all their names recorded in the fabulous records of Greece, may be easily traced up to a

Phœnician

Phœnician original. We agree with Herodotus, that a considerable part of the idolatry of Greece may have been borrowed from the Egyptians; at the same time, we imagine it highly probable, that the idolatry of the Egyptians and Phœnicians was, in its original constitution, nearly the same. Both systems were Sabiism, or the worship of the host of heaven. The Pelasgi, according to Herodotus, learned the names of the gods from the Egyptians; but in this conjecture he is certainly warped by his partiality for that people. Had those names been imported from Egypt, they would no doubt have bewrayed their Egyptian original; whereas, every etymologist will be convinced that every one is of Phœnician extraction.

The adventures of Jupiter, Juno, Mercury, Apollo, Diana, Mars, Minerva or Pallas, Venus, Bacchus, Ceres, Proserpine, Pluto, Neptune, and the other descendants and coadjutors of the ambitious family of the Titans, furnish by far the greatest part of the mythology of Greece. They left Phœnicia, we think, about the age of Moses; they settled in Crete, a large and fertile island; from this region they made their way into Greece, which, according to the most authentic accounts, was at that time inhabited by a race of savages. The arts and inventions which they communicated to the natives; the mysteries of religion which they inculcated; the laws, customs, polity, and good order, which they established; in short, the blessings of humanity and civilization, which they everywhere disseminated, in process of time inspired the unpolished inhabitants with a kind of divine admiration. Those ambitious mortals improved this admiration into divine homage and adoration. The greater part of that worship, which had been formerly addressed to the luminaries of heaven, was now transferred to those illustrious personages. They claimed and obtained divine honours from the deluded rabble of enthusiastic Greeks. Hence sprung an inexhaustible fund of the most inconsistent and irreconcilable fictions.

37 Hence the inconsistent fictions of the Greek poets.

The foibles and frailties of the deified mortals were transmitted to posterity, incorporated as it were with the pompous attributes of supreme divinity. Hence the heterogeneous mixture of the mighty and the mean which chequers the characters of the heroes of the Iliad and Odyssey. The Greeks adopted the oriental fables, the import of which they did not understand. These they accommodated to heroes and illustrious personages, who had figured in their own country in the earliest periods. The labours of Hercules originated in Egypt, and evidently relate to the annual progress of the sun in the zodiac, though the vain-glorious Greeks accommodated them to a hero of their own, the reputed son of Jupiter and Alcmena. The expedition of Osiris they borrowed from the Egyptians, and transferred to their Bacchus, the son of Jupiter and Semele the daughter of Cadmus. The transformation and wanderings of Io are evidently transcribed from the Egyptian romance of the travels of Isis in quest of the body of Osiris, or of the Phœnician Astarte, drawn from Sanchoniathon. *Io* or *Ioh* is in reality the Egyptian name of the moon, and Astarte was the name of the same planet among the Phœnicians. Both these fables are allegorical representations of the anomalies of the lunar planet, or perhaps of the progress of the worship of that planet in different parts of the world. The fable of the conflagration occasioned by Phaeton is clearly of oriental extraction, and alludes to an excessive drought which in the early periods of time scorched Ethiopia and the adjacent countries. The fabulous adventures of Perseus are said to have happened in the same regions, and are allegorical representations of the influence of the solar luminary; for the original Perseus was the sun. The rape of Proserpine and the wanderings of Ceres; the Eleusinian mysteries; the orgia or sacred rites of Bacchus; the rites and worship of the Cabiri—were imported from Egypt and Phœnicia; but strangely garbled and disfigured by the hierophants of Greece. The gigantomachia, or war between the gods and the giants, and all the fabulous events and varieties of that war, form an exact counterpart to the battles of the Peri and Dives, celebrated in the romantic annals of Persia.

38 The Greeks ignorant of oriental languages.

A considerable part of the mythology of the Greeks sprung from their ignorance of the oriental languages. They disdained to apply themselves to the study of languages spoken by people whom, in the pride of their heart, they stigmatized with the epithet of *barbarians*. This aversion to every foreign dialect was highly detrimental to their progress in the sciences. The same neglect or aversion has, we imagine, proved an irreparable injury to the republic of letters in all succeeding ages. The aoids, or strolling bards, laid hold on those oriental legends, which they sophisticated with their own additions and improvements, in order to accommodate them to the popular taste. These wonderful tales figured in their rhapsodical compositions, and were greedily swallowed down by the credulous vulgar. Those fictions, as they rolled down, were constantly augmented with fresh materials, till in process of time their original import was either forgotten or buried in impenetrable darkness. A multitude of these Hesiod has collected in his Theogonia, or Generation of the Gods, which unhappily became the religious creed of the illiterate part of the Greeks. Indeed fable was so closely interwoven with the religion of that airy volatile people, that it seems to have contaminated not only their religious and moral, but even their political tenets.

39 Oracle of Dodona.

The far-famed oracle of Dodona was copied from that of Ammon at Thebes in Egypt: The oracle of Apollo at Delphos was an emanation from the same source: The celebrated Apollo Pythius of the Greeks was no other than *Ob* or *Aub* of the Egyptians, who denominated the basilisk or royal snake *Ov Cai*, because it was held sacred to the sun. *Ob* or *Aub* is still retained in the Coptic dialect, and is one of the many names or epithets of that luminary. In short, the ground-work of the Grecian mythology is to be traced in the east. Only small part of it was fabricated in the country; and what was imported pure and genuine was miserably sophisticated by the hands through which it passed, in order to give it a Grecian air, and to accommodate its style to the Grecian taste. To enlarge upon this topic would be altogether superfluous, as our learned readers must be well acquainted with it already, and the unlearned may without much trouble or expence furnish themselves with books upon that subject.

40 Roman mythology borrowed from Greece.

The Roman mythology was borrowed from the Greeks.

Greeks. That people had addicted themselves for many centuries to the arts of war and civil polity. Science and philosophy were either neglected or unknown. At last they conquered Greece, the native land of science, and then "Græcia capta ferum victorem cepit arte et intulit agresti Latio." This being the case, their mythology was, upon the whole, a transcript from that of Greece. They had indeed gleaned a few fables from the Pelasgi and Hetruscans, which, however, are of so little consequence, that they are scarce worth the trouble of transcribing.

The mythology of the Celtic nations is in a good measure lost. There may possibly still remain some vestiges of the Druidical superstition in the remotest parts of the highlands and islands of Scotland; and perhaps in the uncivilized places of Ireland. These, we presume, would afford our readers but little entertainment, and still less instruction. Instead therefore of giving a detail of those uninteresting articles, we shall beg leave to refer our readers to Ossian's Poems, and Col. Valeney's Collections of Irish Antiquities, for satisfaction on that subject.

41 Mythology of the northern nations.

The mythology of the northern nations, i. e. of the Norwegians, Danes, Swedes, Icelanders, &c. is uncommonly curious and entertaining. The Edda and Voluspa contain a complete collection of fables which have not the smallest affinity with those of the Greeks and Romans. They are wholly of an oriental complexion, and seem almost congenial with the tales of the Persians above described. The Edda was compiled in Iceland in the 13th century. It is a kind of system of the Scandinavian mythology: and has been reckoned, and we believe justly, a commentary on the Voluspa, which was the Bible of the northern nations.

42 Odin or Woden.

Odin or Othin, or Woden or Waden, was the supreme divinity of those people. His exploits and adventures furnish the far greater part of their mythological creed. That hero is supposed to have emigrated from the east; but from what country or at what period is not certainly known. His achievements are magnified beyond all credibility. He is represented as the god of battles, and as slaughtering thousands at a blow. His palace is called *Valhal*: it is situated in the city of Midgard, where, according to the fable, the souls of heroes who had bravely fallen in battle enjoy supreme felicity. They spend the day in mimic hunting matches, or imaginary combats. At night they assemble in the palace of Valhalla, where they feast on the most delicious viands, dressed and served up by the *Valkyriæ*, virgins adorned with celestial charms, and flushed with the bloom of everlasting youth. They solace themselves with drinking mead out of the skulls of enemies whom they killed in their days of nature. Mead, it seems, was the nectar of the Scandinavian heroes.

43 The hell and devil of the Scandinavians.

Sleepner, the horse of Odin, is celebrated along with his master. Hela, the hell of the Scandinavians, affords a variety of fables equally shocking and heterogeneous. Loke, the evil genius or devil of the northern people, nearly resembles the Typhon of the Egyptians. Signa or Sinna is the consort of Loke; from this name the English word *sin* is derived. The giants Weymur, Ferbanter, Belupher, and Hellunda, perform a variety of exploits, and are exhibited in the most frightful attitudes. One would be tempted to imagine, that they perform the exact counterpart of the giants of the Greek and Roman mythologists. Instead of glancing at these ridiculous and uninteresting fables, which is all that the limits prescribed us would permit, we shall take the liberty to lay before our readers a brief account of the contents of the Voluspa, which is indeed the text of the Scandinavian mythology.

44 The Voluspa.

The word *Voluspa* imports, "the prophecy of Vola or Fola." This was, perhaps, a general name for the prophetic ladies of the north, as Sibyl was appropriated to women endowed with the like faculty in the south. Certain it is, that the ancients generally connected madness with the prophetic faculty. Of this we have two celebrated examples: the one in Lycophron's Alexandra, and the other in the Sibyl of the Roman poet. The word *vola* signifies "mad or foolish;" whence the English words *fool*, *foolish*, *folly*. *Spa*, the latter part of the composition, signifies "to prophecy," and is still current among the common people in Scotland, in the word *Spae*, which has nearly the same signification.

The Voluspa consists of between 200 and 300 lines. The prophetess having imposed silence on all intelligent beings, declares that she is about to reveal the works of the Father of nature, the actions and operations of the gods, which no mortal ever knew before herself. She then begins with a description of the chaos; and then proceeds to the formation of the world, the creation of the different species of its inhabitants, giants, men, and dwarfs. She then explains the employments of the fairies or destinies, whom the northern people call *nornies;* the functions of the deities, their most memorable adventures, their disputes with Loke, and the vengeance that ensued. She at last concludes with a long and indeed animated description of the final state of the universe, and its dissolution by a general conflagration.

In this catastrophe, Odin and all the rabble of the Pagan divinities, are to be confounded in the general ruin, no more to appear on the stage of the universe. Out of the ruins of the former world, according to the Voluspa, a new one shall spring up, arrayed in all the bloom of celestial beauty.

Such is the doctrine exhibited in the fabulous Voluspa. So congenial are some of the details therein delivered, especially those relating to the final dissolution of the present system, and the succession of a new heaven and a new earth, that we find ourselves strongly inclined to suspect, that the original fabricator of the work was a semipagan writer, much of the same complexion with the authors of the Sibylline oracles, and of some other apocryphal pieces which appeared in the world during the first ages of Christianity.

45 Mythology of Mexico and Peru.

In America, the only mythological countries must be Mexico and Peru. The other parts of that large continent were originally inhabited by savages, most of them as remote from religion as from civilization. The two vast empires of Mexico and Peru had existed about 400 years only before the Spanish invasion. In neither of them was the use of letters understood; and of course the ancient opinions of the natives relating to the origin of the universe, the changes which succeeded, and every other monument of antiquity, were obliterated and lost. Clavigero has indeed enumerated a vast canaille of sanguinary gods worshipped by the Mexicans;

Mexicans; but produces nothing either entertaining or interesting with respect to their mythology. The information to be derived from any other quarter is little to be depended upon. It passes through the hands of bigotted missionaries or other ecclesiastics, who were so deeply tinctured with fanaticism, that they viewed every action, every sentiment, every custom, every religious opinion and ceremony of those half-civilized people, through a false medium. They often imagined they discovered resemblances and analogies betwen the rites of those savages and the dogmas of Christianity, which nowhere existed but in their own heated imagination.

The only remarkable piece of mythology in the annals of the Peruvians, is the pretended extraction of Manco Capec the first Inca of Peru, and of Mama Ocolla his consort. These two illustrious personages appeared first on the banks of the lake Titiaca. They were persons of a majestic stature, and clothed in decent garments. They declared themselves to be the children of the Sun, sent by their beneficent parent, who beheld with pity the miseries of the human race, to instruct and to reclaim them. Thus we find these two legislators availed themselves of a pretence which had often been employed in more civilized regions to the very same purposes. The idolatry of Peru was gentle and beneficent, that of Mexico gloomy and sanguinary. Hence we may see, that every mode of superstition, where a divine revelation is not concerned, borrows its complexion from the characters of its professors.

In the course of this article, our readers will observe, that we have not much enlarged upon the mythology of the Greeks and Romans; that subject we imagine to be so universally known by the learned, and so little valued by the vulgar, that a minute discussion of it would be altogether superfluous. Besides, we hope it will be remembered, that the narrowness of the limits prescribed us would scarce admit of a more copious detail. We would flatter ourselves, that in the course of our disquisition, we have thrown out a few reflections and observations, which may perhaps prove more acceptable to both descriptions of readers.

M Y U

Mytilus || Myus.

MYTILUS, the MUSSEL, a genus of animals, belonging to the order of vermes testacea. See CONCHOLOGY *Index*.

MYTTOTON, a coarse kind of food, used by the labouring people among the Greeks, and sometimes among the Romans. It was made of garlic, onions, eggs, cheese, oil, and vinegar, and reckoned very wholesome.

MYUS, in *Ancient Geography*, one of the twelve towns of Ionia; seated on the Meander, at the distance of 30 stadia from the sea. In Strabo's time it was incorporated with the Milesians, on account of the paucity of inhabitants, from its being formerly overwhelmed with water: for which reason the Ionians consigned its suffrage and religious ceremonies to the people of Miletus. Artaxerxes allotted this town to Themistocles, in order to furnish his table with meat: Magnesia was to support him in bread, and Lampsacus in wine. The town now lies in ruins.

M Y X

Myus || N.

MYXINE, the HAG; a genus of animals belonging to the order of vermes intestina. See HELMINTHOLOGY *Index*.

N.

N, A liquid consonant, and the 13th letter of the Greek, Latin, English, &c. alphabets.

The *n* is a nasal consonant: its sound is that of a *d*, passed through the nose; so that when the nose is stopped by a cold, or the like, it is usual to pronounce *d* for *n*. M. Abbe de Dangeau observes, that in the French, the *n* is frequently a mere nasal vowel, without any thing of the consonant in it. He calls it the Sclavonic vowel. The Hebrews call their *n nun*, which signifies child, as being supposed the offspring of *m*; partly on account of the resemblance of sound, and partly on that of the figure. Thus from the *m*, by omitting the last column, is formed *n*; and thus from the capital N, by omitting the first column, is formed the Greek minuscle ν. Hence from *biennies*, &c. the Latins frequently use *bimus*, &c. and the same people convert the Greek ν, at the end of a word, into an *m*, as φαρμακον, *pharmacum*, &c. See M.

N before *p*, *b*, and *m*, the Latins change into *m*, and frequently into *l* and *r*; as in *in-ludo*, *illudo*; *inrigo*, *irrigo*, &c.: in which they agree with the Hebrews, who, in lieu of *nun*, frequently double the following consonants: and the Greeks do the same; as when for *Manlius*, they write Μαλλιος, &c. The Greeks also, before κ, γ, χ, ν, changed the ν into γ: in which they were followed by the ancient Romans: who, for *Angulus*, wrote *Aggulus*; for *anceps*, *ageeps*, &c.

The Latins retrench the *n* from Greek nouns end-

N || Nabis.

ing in ων; as Λεων, *Leo*; Δρακων, *Draco*; on the contrary, the Greeks add it to the Latin ones ending in *o*; as Κατων, Νερων *Cato*, *Nero*.

N, among the ancients, was a numeral letter, signifying 900; according to the verse in Baronius,

N, quoque nongentos numero designat habendos.

And when a line was struck over it, $\bar{N}$, nine thousand. Among the ancient lawyers, *N. L.* stood for *non liquet*, i. e. the cause is not clear enough to pass sentence upon. N, or N°, in commerce, &c. is used as an abbreviation of *numero*, number.

NAARDA, NEARDA, *Neerda*, or *Nehardea*, in *Ancient Geography*, a town situated on the confines of Mesopotamia and Babylonia; populous, and with a rich and extensive territory, not easily to be attacked by an enemy, being surrounded on all sides by the Euphrates and strong walls (Josephus). In the lower age the Jews had a celebrated school there.

NAAS, a borough town of Ireland, in the county of Kildare and province of Leinster. It is the shire town of that county, and alternately with Athy the assizes town. It is distant above 15 miles south-west from Dublin, in N. Lat. 53. 10. W. Long. 6. 50. It gives title of viscount to the family of Burke. This place was anciently the residence of the kings of Leinster: the name signifies "the place of elders," for here the states of that province assembled during the 6th, 7th, and 8th centuries, after the Naasteighan of Carmen had been anathematized by the Christian clergy. On the arrival of the English it was fortified; many castles were erected, the ruins of which are partly visible; and parliaments were held there. At the foot of the mount or rath are the ruins of a house founded in 1484, for eremites of the order of St Augustin. In the 12th century the baron of Naas founded a priory dedicated to St John the Baptist, for Augustinian regular canons. In the centre of this town the family of Eustace erected a monastery for Dominican friars, dedicated to St Eustachius; and it appears that their possessions in Naas were granted them in the year 1355. This place was a strong hold during the civil wars.

NABATENE, or REGIO NABATÆORUM, according to Jerome, comprised all the country lying between the Euphrates and the Red sea, and thus contained Arabia Deserta, with a part of the Petræa: so called from Nabaioth, the first born of Ismael. According to Diodorus, it was situated between Syria and Egypt. The people Nabatæi (1 Maccabees, Diodorus Sieulus): inhabiting a desert and barren country: they lived by plundering their neighbours, according to Diodorus. Nabathæus the epithet.

NABIS, tyrant of Sparta, reigned about 204 B. C.; and is reported to have exceeded all other tyrants so far, that, upon comparison, he left the epithets of *gracious* and *merciful* to Dionysius and Phalaris. He is said to have contrived an instrument of torture in the form of a statue of a beautiful woman, whose rich dress concealed a number of iron spikes in her bosom and arms. When any one therefore opposed his demands, he would say, "If I have not talents enough to prevail with you, perhaps my woman Apega may persuade you." The statue then appeared; which Nabis taking by the hand, led up to the person, who, being embraced by it, was thus tortured into compliance. To render his tyranny less unpopular, Nabis made an alliance with Flaminius the Roman general, and pursued with the most inveterate enmity the war which he had undertaken against the Achæans. He besieged Gythium, and defeated Philopœmen in a naval battle. His triumph was short, the general of the Achæans soon repaired his losses, and Nabis was defeated in an engagement, and killed as he attempted to save his life by flight, about 194 years before the Christian era.

Nabis || Nabuchadnezzar.

NABLOUS, a province of Syria, anciently celebrated under the name of the *kingdom of Samaria*. Its capital, likewise called *Nablous*, is situated near to Sichem on the ruins of the Niepolis of the Greeks, and is the residence of a sheik, who is subordinate to the pacha of Damascus, from whom he farms the tribute of the province.

NABLUM, in Hebrew, *Nebel*, was an instrument of music among the Jews. It had strings like the harp, and was played upon by both hands. Its form was that of a Greek A. In the Septuagint and Vulgate, it is called *noblum*, *psalterion*, *lyra*; and sometimes *cithara*.

NABO, or NEBO, in *Mythology*, a deity of the Babylonians, who possessed the next rank to Bel. It is mentioned by Isaiah, chap. xlviii. Vossius apprehends that Nabo was the moon, and Bel the sun: but Grotius supposes that Nabo was some celebrated prophet of the country; which opinion is confirmed by the etymology of the name, signifying, according to Jerome, "one that presides over prophecy."

NABOB, properly NAVAB, the plural of *Naib*, a deputy. As used in Bengal, it is the same as NAZIM. It is a title also given to the wives and daughters of princes, as well as to the princes themselves.

NABONASSAR, first king of the Chaldeans or Babylonians; memorable for the Jewish era which bears his name, which is generally fixed in 3257, beginning on Wednesday, February 26th, in the 3967th of the Julian period, 747 years before Christ. The Babylonians revolting from the Medes, who had overthrown the Assyrian monarchy, did, under Nabonassar, found a dominion, which was much increased under Nebuchadnezzar It is probable, that this Nabonassar is that Baladan in the second of Kings, xx. 12. father of Merodach, who sent ambassadors to Hezekiah. See 2 Chron. xxxii.

NABOPOLASSAR, king of Babylon: he joined with Astyages the Mede, to destroy the empire of Assyria; which having accomplished, they founded the two empires of the Medes under Astyages, and the Chaldeans under Nabopolassar, 627 B. C.

NABUCHADNEZZAR, or NABUCHODONOSOR II. king of Assyria, son of Nabopolassar, and styled the *Great*, was associated by his father in the empire, 607 B. C. and the following year he took Jehoiakim king of Judah prisoner, and proposed to carry him and his subjects in captivity into Babylon; but upon his submission, and promising to hold his kingdom under Nabuchodonosor, he was permitted to remain at Jerusalem In 603 B. C. Jehoiakim attempted to shake off the Assyrian yoke, but without success; and this revolt brought on the general captivity. Nabuchadnezzar having subdued the Ethiopians, Arabians, Idumæans, Philistines, Syrians, Persians, Medes, Assyrians,

Nabuchadnezzar || Nævus.

syrians, and almost all Asia; being puffed up with pride, caused a golden statue to be set up, and commanded all to worship it; which Daniel's companions refusing to do, they were cast into the fiery furnace. But as he was admiring his own magnificence, by divine sentence he was driven from men, and in the Scripture style is said to have eaten grass as oxen: i. e. he was seized with the disease called by the Greeks *lycanthropy*, which is a kind of madness that causes persons to run into the fields and streets in the night, and sometimes to suppose themselves to have the heads of oxen, or to be made of glass. At the end of seven years his reason returned to him, and he was restored to his throne and glory. He died 562 B. C. in the 43d year of his reign; in the 5th of which happened that eclipse of the sun mentioned by Ptolemy, which is the surest foundation of the chronology of his reign.

NADIR, in *Astronomy*, that point of the heavens which is diametrically opposite to the zenith or point directly over our heads.

NÆNIA, the goddess of funerals at Rome. Her temple was without the gates of the city. The songs which were sung at funerals were also called *nænia*. They were generally filled with the praises of the deceased; but sometimes they were so unmeaning and improper, that the word became proverbial to signify nonsense.

NAERDEN, a strong town of Holland, seated at the head of the canals of the province. The foundations of it were laid by William of Bavaria, in 1350. It was taken by the Spaniards in 1572, and by the French in 1672; but it was retaken by the prince of Orange the next year. It stands at the south end of the Zuyder Zee, in E. Long. 5. 3. N. Lat. 51. 22.

NÆVIUS, Cneius, a famous poet of Campania, was bred a soldier; but quitted the profession of arms, in order to apply himself to poetry, which he prosecuted with great diligence. He composed a history in verse, and a great number of comedies: but it is said that his first performance of this last kind so displeased Metellus on account of the satirical strokes it contained, that he procured his being banished from the city: on which he retired to Utica in Africa, where he at length died, 202 B. C. We have only some fragments left of his works.

There was another Nævius, a famous augur in the reign of Tarquin, who, to convince the king and the Romans of his preternatural power, cut a flint with a razor, and turned the ridicule of the populace to admiration. Tarquin rewarded his merit by erecting him a statue in the comitium, which was still in being in the age of Augustus. The razor and flint were buried near it under an altar, and it was usual among the Romans to make witnesses in civil causes swear near it. This miraculous event of cutting a flint with a razor, though believed by some writers, is treated as fabulous and improbable by Cicero, who himself had been augur.

NÆVUS, a mole on the skin, generally called a *mother's mark*; also the tumour known by the name of a *wen*.

All preternatural tumours on the skin, in the form of a wart or tubercle, are called *excrescences*; by the Greeks they are called *acrothymia*; and when they are born with a person, they are called *nævi materni*, or *marks from the mother*. See Tumours, Surgery *Index*.

Nævus || Nail.

NAGERA, or Nagara, a town of Spain, in Old Castile, and the territory of Rioja, with the title of a duchy and fortress; famous for a battle fought in its neighbourhood in 1369. It is situated in a fertile country, on a brook called *Naserilla*. W. Long. 2. 20. N. Lat. 42. 45.

NAGRACUT, a town of India, the capital of a kingdom of the same name in the dominions of the Great Mogul, with a rich temple to which the Indians go in pilgrimage. It is seated on the river Ravi. E. Long. 78. 10. N. Lat. 33. 12.

NAHUM, or the *Prophecy of Nahum*, a canonical book of the Old Testament.

Nahum, the seventh of the 12 lesser prophets, was a native of Elkoshai, a little village of Galilee. The subject of his prophecy is the destruction of Nineveh, which he describes in the most lively and pathetic manner; his style is bold and figurative, and cannot be exceeded by the most perfect masters of oratory. This prophecy was verified at the siege of that city by Astyages, in the year of the world 3378, 622 years before Christ.

NAIADES, in fabulous history, certain inferior deities who presided over rivers, springs, wells, and fountains. The Naiades generally inhabited the country, and resorted to the woods or meadows near the stream over which they presided. They are represented as young and beautiful virgins, often leaning upon an urn, from which flows a stream of water. Ægle was the fairest of the Naiades, according to Virgil. Their name seems to be derived from ναειν, "to flow." They were held in great veneration among the ancients; and often sacrifices of goats and lambs were offered to them, with libations of wine, honey, and oil. Sometimes they received only offerings of milk, fruit, and flowers.

NAIANT, in *Heraldry*, a term used in blazoning fishes, when borne in a horizontal posture, as if swimming.

NAIAS, a genus of plants belonging to the diœcia class; and in the natural method ranking with those of which the order is doubtful. See Botany *Index*.

NAID, the interior of the great desert of Arabia, inhabited by a few scattered tribes of feeble and wretched Arabs. See Arabia.

NAIL, Unguis, in *Anatomy*, which see.

Nails, in building, &c. small spikes of iron, brass, &c. which being driven into wood, serve to bind several pieces together, or to fasten something upon them.

Nails were made use of by the ancient Hebrews for cancelling bonds; and the ceremony was performed by striking them through the writing. This seems to be alluded to in Scripture, where God is said by our crucified Saviour to have "blotted out the hand-writing of ordinances that was against us, and to have taken it out of the way, nailing it to his cross," Col. ii. 14. For the cause and ceremony of driving the annual nail, or *clavus annalis*, among the Romans, see *Annalis Clavus*.

Nail, is also a measure of length, containing the 16th part of a yard

Nailing of Cannon || Nairn.

Nailing of Cannon. When circumstances make it necessary to abandon cannon, or when the enemy's artillery are seized, and it is not however possible to take them away, it is proper to nail them up, in order to render them useless; which is done by driving a large nail or iron spike into the vent of a piece of artillery, to render it unserviceable. There are various contrivances to force the nail out, as also sundry machines invented for that purpose, but they have never been found of general use; so that the best method is to drill a new vent.

One Gasper Vimercalus was the first who invented the nailing of cannon. He was a native of Bremen, and made use of his invention first in nailing up the artillery of Sigismund Malatesta.

NAIN, Lewis Sebastian de, a French critic and historian, was the son of a master of the requests, and was born at Paris in 1637. At ten years old he went to school at Port Royal, and became one of the best writers of that institution. Sacy, his intimate friend and counsellor, prevailed with him in 1676 to receive the priesthood; which it seems, his great humility would not before suffer him to aspire to. This virtue he seems to have possessed in the extreme; so that Bossuet, seeing one of his letters to Father Dami, with whom he had some little dispute, besought him merrily "not to be always upon his knees before his adversary, but raise himself up now and then." He was solicited to push himself forward in the church, and Buzanval, bishop of Beauvois, wished to have him for his successor; but Nain, regardless of dignities, wished for nothing but retirement, so that he might indulge in the mortifications of a religious life and the indefatigable cultivation of letters. He died in 1698, aged 61. His principal works are, 1. Memoirs on the ecclesiastical history of the six first ages of the church, 16 vols. 4to. 2. The history of the emperors, 6 vols. 4to. These works are deduced from original sources, and composed with the utmost fidelity and accuracy.

Nain, or Naim, situated at the bottom of Mount Hermon on the north side, was anciently a city of the tribe of Issachar, in the province of Galilee. It was near the gates of this city that our Saviour restored to life the only son of a widow, and where he inspired Mary Magdalen to come and mourn for her sins at his feet. These circumstances alone make this place worthy of notice; for at present Nain is only a hamlet inhabited by Christians, Mahometans, and Hebrews, where there is not a single monument to attract the curiosity of the traveller.

NAIRES, Nahers, or Nayers, in modern history, a name which is given by the Malabarians to the military of their country, who form a very numerous class or tribe, out of which the sovereigns of Malabar choose their body guard.

NAIRN, a county of Scotland, comprehending the western part of the province of Murray. It is bounded on the north by the Murray frith, on the west and south by Inverness, and on the east by Elgin. The length is about 18 miles, and the breadth about 14. The air is temperate and salubrious, and the winters are remarkably mild. The face of the country is rough and mountainous: yet there are some fruitful valleys which produce good crops of oats and barley; but in general the country is much better adapted for pasturage. Here are also large woods of fir, and other trees, that afford shelter to the game, of which there is great plenty. The most remarkable straths or valleys in this county, are Strathnairn, on the river of that name, in the south-west part of the shire; and on the south-east side, Strathrin, on both sides of Findhorn river. Nairn is well watered with streams, rivulets, and lakes abounding with fish. In the southern part there is a small lake, called *Moy*. The greater part of the shire is peopled by the Frazers, a warlike Highland clan, whose chief, the lord Lovat, lost his life on the scaffold for having been concerned in the rebellion of 1745. Here are a great number of villages; but no towns of note except Nairn, supposed to be the *Tuæsis* of Ptolemy, situated at the mouth of the river which bears the same name; a royal borough, which gave the title of *lord* to an ancient family, forfeited in the rebellion of 1715. The harbour, which opened in the Murray frith, is now choked up with sand; and the commerce of the town is too inconsiderable to deserve notice. About four miles from Nairn stands the castle of Calder on the river of that name, belonging to a branch of the family of Campbell; and six miles to the north-west of Nairn stands Fort George.

Nairn || Naissus.

The following is the population of the parishes of this county, according to the Statistical History of Scotland.

Parishes.	Population in 1755.	Population in 1790—1798.
Ardclach	1163	1186
Auldearn	1951	1406
Calder	882	1062
Nairn	1698	2400
	5694	6054
		5694
	Increase	360

Population in 1801, *including part of some other Parishes.*

Ardclach - -	1256
Auldearn - -	1401
Calder - - -	1179
Croy (Nairn division) -	562
Moy do. - -	34
Nairn - - town	2215
Urquhart (do.) - -	1610
	8257

In the returns for 1811 the population of Nairn is stated to be 8251. See Nairn, Supplement.

NAISSANT, in *Heraldry*, is applied to any animal issuing out of the midst of some ordinary, and showing only his head, shoulders, fore feet, and legs, with the tip of his tail; the rest of his body being hid in the shield, or some charge upon it: in which it differs from *issuant*, which denotes a living creature arising out of the bottom of any ordinary or charge.

NAISSUS, in *Ancient Geography*, a town of Dardania, a district of Mœsia Superior, said to be the birthplace of Constantine the Great, which seems probable from his often residing at that place. *Naisitani*, the

Naissus || Names.

the people (Coin). Now called *Nissa*, a city of Servia. E. Long. 23. N. Lat. 43.

NAKED SEEDS, in *Botany*, those that are not enclosed in any pod or case.

NAKIB, in the oriental dignities, the name of an officer who is a deputy to the cadiliskier, or, as he may be called, the lord high chancellor of Egypt, appointed by the grand signior. His office is to carry the standard of Mahomet.

NAKOUS, an Egyptian musical instrument, made like two plates of brass, and of all sizes, from two inches to a foot in diameter; they hold them by strings fastened to their middles, and strike them together so as to beat time. They are used in the Coptic churches and in the Mahometan processions.

NAMA, a genus of plants belonging to the pentandria class, and order digynia; and, in the natural method, ranking under the 13th order, *Succulentæ*. See BOTANY *Index*.

NAME, denotes a word whereby men have agreed to express some idea; or which serves to denote or signify a thing or subject spoken of. See WORD.

This the grammarians usually call a *noun*, *nomen*, though their noun is not of quite so much extent as our name. See NOUN.

Seneca, lib. ii. *de Beneficiis*, observes, that there are a great number of things which have no name; and which, therefore, we are forced to call by other borrowed names. *Ingens est* (says he) *rerum copia sine nomine, quas cum propriis appellationibus signare non possumus, alienis accommodatis utimur:* which may show why, in the course of this dictionary, we frequently give divers senses to the same word.

Names are distinguished into *proper* and *appellative*.

Proper NAMES, are those which represent some individual thing or person, so as to distinguish it from all other things of the same species; as, *Socrates*, which represents a certain philosopher.

Appellative or *General* NAMES, are those which signify common ideas; or which are common to several individuals of the same species; as, *horse*, *animal*, *man*, *oak*, &c.

Proper names are either called *Christian*, as being given at baptism; or surnames: The first imposed for distinction of persons, answering to the Roman *prænomen;* the second, for the distinction of families, answering to the *nomen* of the Romans, and the *patronymicum* of the Greeks.

Originally every person had but one name; as among the Jews, *Adam*, &c. among the Egyptians, *Busiris;* among the Chaldees, *Ninus;* the Medes, *Astyages;* the Greeks, *Diomedes;* the Romans, *Romulus;* the Gauls, *Divitiacus;* the Germans, *Ariovistus;* the Britons, *Cassibelan;* the English, *Hengist*, &c. And thus of other nations, except the savages of Mount Atlas, whom Pliny and Marcellinus represent as *anonymi*, "nameless."

The Jews gave the name at the circumcision, viz. eight days after the birth: the Romans, to females the same day, to males the ninth; at which time they held a feast, called *nominalia*.

Since Christianity has obtained, most nations have followed the Jews, baptizing and giving the name on the eighth day after the birth; except our English ancestors, who, till of late, baptized and gave the name on the birth day. Names.

The first imposition of names was founded on different views, among different people; the most common was to mark the good wishes of the parents, or to entitle the children to the good fortune a happy name seemed to promise. Hence, *Victor*, *Castor*, *Faustus*, *Statorius*, *Probus*, &c.

Accordingly, we find such names, by Cicero called *bona nomina*, and by Tacitus *fausta nomina*, were first enrolled and ranged in the Roman musters; first called to serve at the sacrifices, in the foundation of colonies, &c.—And, on the contrary, Livy calls Atrius Umber, *abominandi omnis nomen:* and Plautus, on occasion of a person named *Lyco*, i. e. "greedy wolf," says;

Vosmet nunc facite conjecturam cæterum
Quid id sit hominis, cui Lyco *nomen fiet.*

Hence, Plato recommends it to men to be careful in giving happy names; and the Pythagoreans taught expressly, that the minds, actions, and successes of men, were according to their names, genius, and fate. Thus Panormitan, *ex bono nomine oritur bona præsumptio;* and the common proverb, *Bonum nomen bonum omen;* and hence the foundation of the onomomantia. See ONOMOMANTIA.

It is an observation deserving attention, says the abbé Barthelemi, that the greater part of names found in Homer are marks of distinction. They were given in honour of the qualities most esteemed in the heroic ages. From the word *polemos*, which signifies war, have been formed *Tlepolemus* and *Archepolemus*, the names of two heroes mentioned in the Iliad. The former name signifies *able to support*, and the latter, *able to direct, the labours of war*. By adding to the word *miache*, or *battle*, certain prepositions and different parts of speech, which modify the sense in a manner always honourable, are composed the names *Amphimachus*, *Antimachus*, *Promachus*, *Telemachus*. Proceeding in the same way, with the word *honorea*, "strength or intrepidity," they formed the names *Agapenor*, "he who esteems valour;" *Agenor*, "he who directs it." From *thoes*, "swift," are derived, *Alcathoes*, *Panthoes*, *Perithoes*, &c. From *nous*, "mind or intelligence," come *Astynoes*, *Arsinoes*, *Autenoes*, &c. From *medes*, "counsel," *Agamedes*, *Eumedes*, *Lycomedes*, *Thrasymedes;* and from *clios*, "glory," *Amphicles*, *Agacles*, *Iphicles*, *Patroclus*, *Cleobulus*, with many others.

Hence Camden takes it for granted, that the names, in all nations and languages, are significative, and not simple sounds for mere distinction's sake. This holds not only among the Jews, Greeks, Latins, &c. but even the Turks; among whom, Abdala signifies *God's servant;* Soliman, *peaceable;* Mahomet, *glorified*, &c. And the savages of Hispaniola, and throughout America, who, in their languages, name their children, *Glistering Light*, *Sun*, *Bright*, *Fine Gold*, &c.; and they of Congo, by the names of precious stones, flowers, &c.

To suppose names given without any meaning, however by the alteration of language their signification may be lost, that learned author thinks is to reproach our ancestors; and that contrary to the sense

of

Names. of all ancient writers. Porphyry notes, that the barbarous *names*, as he calls them, were very emphatical, and very concise: and accordingly it was esteemed a duty to be φηρωνυμοι, or *sui nominis homines:* as Severus, Probus, and Aurelius, are called *sui nominis imperatores.*

It was the usual way of giving names, to wish the children might discharge their names. Thus when Gunthram king of France named Clotharius at the font, he said, *Crescat puer, et hujus sit nominis executor.*

The ancient Britons, Camden says, generally took their names from colours, because they painted themselves; which names are now lost, or remain hid among the Welsh. When they were subdued by the Romans, they took Roman names, some of which still remain corrupted; though the greatest part became extinct upon the admission of the English Saxons, who introduced the German names, as *Cridda, Penda, Oswald, Edward,* &c.—The Danes, too, brought with them their names; as *Suayne, Harold, Knute,* &c. The Normans, at the Conquest, brought in other German names, as originally using the German tongue; such as *Robert, William, Richard, Henry, Hugh,* &c. after the same manner as the Greek names *Aspasius, Boethius, Symmachus,* &c. were introduced into Italy upon the division of the empire. After the Conquest, our nation, which had ever been averse to foreign names, as deeming them unlucky, began to take Hebrew names: as *Matthew, David, Samson,* &c. The various names anciently or at present obtaining among us, from what language or people soever borrowed, are explained by Camden in his Remains. As to the period when names began to be multiplied, and surnames introduced, &c. see SURNAME.

Of late years it has obtained among us to give surnames for Christian names; which some dislike, on account of the confusion it may introduce. Camden relates it as an opinion, that the practice first began in the reign of Edward VI. by such as would be godfathers, when they were more than half fathers. Upon which some were persuaded to change their names at confirmation; which, it seems, is usual in other countries. —Thus, two sons of Henry II. of France, christened *Alexander* and *Hercules,* changed them at confirmation into *Henry* and *Francis.* In monasteries, the religious assume new names at their admittance, to show they are about to lead a new life, and have renounced the world, their family, and even their name: v. g. sister Mary *of the Incarnation,* brother Henry *of the Holy Sacrament,* &c. The popes also changed their names at their exaltation to the pontificate; a custom first introduced by Pope Sergius, whose name till then, as Platina informs us, was *Swine's-snout.* But Onuphrius refers it to John XII. or XIII. and at the same time adds a different reason for it from that of Platina, viz. that it was done in imitation of St Peter and St Paul, who were first called *Simon* and *Saul.*

Among the ancients, those deified by the Heathen consecrations had new names given them; as Romulus was called *Quirinus;* Melicertes, *Portunus* or *Portumnus,* &c.

New names were also given in adoptions, and sometimes by testament? thus L. Æmilius, adopted by Scipio, took the name of *Scipio Africanus;* and thus Augustus, who was at first called *C. Octavius Thurinus,* being adopted by the testament of Julius Cæsar into his name and family, took the name of *Caius Julius Cæsar Octavianus.* Names || Namur.

Names were also changed at enfranchisements into new cities. Thus Lucumo, at his first being made free of Rome, took the name *Lucius Tarquinius Priscus,* &c.; and slaves when made free, usually assumed their masters names. Those called to the equestrian order, if they had base names, were always new named, *nomini ingenuorum veterumque Romanorum.* And among the primitive Christians, it was the practice to change the names of the catechumens: Thus the renegado Lucianus, till his baptism, was called *Lucius.*

Towards the middle of the 15th century, it was the fancy of the wits and learned men of the age, particularly in Italy, to change their baptismal names for classical ones. As Sannazarius, for instance, who altered his own plain name *Jacopo* to *Actius Syncerus.* Numbers did the same, and among the rest Platina the historian at Rome, who, not without a solemn ceremonial, took the name of *Callimachus* instead of *Philip.* Pope Paul II. who reigned about that time, unluckily chanced to be suspicious, illiterate, and heavy of comprehension. He had no idea that persons could wish to alter their names unless they had some bad design, and actually scrupled not to employ imprisonment and other violent methods to discover the fancied mystery. Platina was most cruelly tortured on this frivolous account: he had nothing to confess: so the pope, after endeavouring in vain to convict him of heresy, sedition, &c. released him after a long imprisonment.

NAMPTWICH, or NANTWICH, a town of Cheshire in England, situated on the river Weever, 14 miles S. E. from Chester, and 162 miles from London. It lies in the Vale Royal, and is one of the largest and best built towns in the county, the streets being very regular, and adorned with many gentlemen's houses. The inhabitants amounting in 1811 to 3999, trade in corn, cattle, cheese, fine white salt, and shoes. It is governed by a constable, &c. who are guardians of the salt springs. It is divided into two equal parts by the Weever, which is navigable to Winsford bridge. The Chester canal, terminates in a large bason near this place. In this town were several religious foundations, now no more. The church is a handsome pile of building in the form of a cross, with an octangular tower in the middle.

NAMUR, a province in the kingdom of the Netherlands, lying between the rivers Sambre and Maese; bounded on the north by Brabant, on the east and south by Liege, and on the west by Hainault. It is pretty fertile; has several forests, marble quarries, and mines of iron, lead, and pit coal; and is about 30 miles long and 20 broad. Namur is the capital town.

NAMUR, a large, rich, and very strong town of the Netherlands, capital of the county of Namur, with a strong castle, several forts, and a bishop's see. It contains 15,400 inhabitants. The most considerable forts are, Fort William, Fort Maese, Fort Coquelet, and Fort Espinor. The castle is built in the middle of the town, on a craggy rock. It was besieged by King William in 1695, who took it in the sight of an army of 100,000 French, though there were 16,000 men in the garrison. It was ceded to the house of Austria

Namur || Nan-king.

in 1713, but taken by the French in 1746; and and restored by the treaty of Aix-la-Chapelle. It was again taken by the French in 1794, and remained in their possession till 1814, when it was ceded to the king of the Netherlands. It is situated at the confluence of the rivers Maese and Sambre, in E. Long. 4. 57. N. Lat, 50. 25.

NAN-TCHANG-FOU, the capital of Kiang-si, a province of China. This city has no trade but that of porcelain, which is made in the neighbourhood of Jao-tcheou. It is the residence of a viceroy, and comprehends in its district eight cities; seven of which are of the third class, and only one of the second. So much of the country is cultivated, that the pastures left are scarcely sufficient for the flocks.

NANCI, a town of France, in the department of Meurthe, situated near the river Meurthe, and containing 29,740 inhabitants in 1800. It is divided into the Old and New Towns. The first is irregularly built, and contains the ducal palace: the streets of the New Town are as straight as a line, adorned with handsome buildings, and a very fine square. The primatial church is a magnificent structure, and in that of the Cordeliers are the tombs of the ancient dukes. The manufactures are cloths, woollen stuffs, silks, hats, iron ware, &c. The town was very well fortified, but the king of France demolished the fortifications. It has been taken and retaken several times; but has belonged to France ever since 1736. E. Long. 6. 17. N. Lat. 48. 41.

NANCOWRY, or SOWRY, one of the Nicobar islands, lying at the entrance of the bay of Bengal. See NICOBAR.

NANI, JOHN BAPTIST, was born in 1616. His father was procurator of St Mark, and ambassador from Venice to Rome. He was educated with attention, and make considerable improvement. Urban VIII. a just valuer of merit, soon perceived that of young Nani. He was admitted into the college of senators in 1641, and was shortly after nominated ambassador in France, where he signalized himself by his compliant manners. He procured considerable succours for the war of Candia against the Turks; and became, after his return to Venice, superintendant of the war office and of finances. He was afterwards ambassador to the empire: where he rendered those services to his country which, as a zealous and intelligent citizen, he was well qualified to discharge. He was again sent into France in 1660 to solicit fresh succours for Candia; and on his return was appointed procurator of St Mark. He died November 5. 1768, at the age of 63, much regretted by his countrymen. The senate had appointed him to write the History of the Republic; which he executed to the satisfaction of the Venetians, although the work was less admired by foreigners, who were not proper judges of the accuracy with which he stated the facts, of the purity of his diction, nor of the simplicity of his style; although it must be acknowledged that his narrative is much interrupted by too frequent parentheses. In writing his history of Venice he has given an universal history of his times, especially with respect to the affairs of the French in Italy. This history, which is continued from 1613 to 1671, was printed at Venice in 2 vols 4to, in the years 1662 and 1679.

NAN-KING, a city of China, and capital of the province of Kiang-nan, is said to have been formerly one of the most beautiful and flourishing cities in the world. When the Chinese speak of its extent, they say, if two horsemen should go out by the same gate, and ride round it on full speed, taking different directions, they would not meet before night. This account is evidently exaggerated; but it is certain, that Nan-king surpasses in extent all the other cities of China. We are assured that its walls are five leagues and a half in circumference. Nan-king.

This city is situated at the distance of a league from the river Yang-tse-kiang: it is of an irregular figure; the mountains which are within its circumference having prevented its being built on a regular plan. It was formerly the imperial city; for this reason it was called *Nan-King*, which signifies, the Southern Court;" but since the six grand tribunals have been transferred from hence to Peking, it is called *Kiang-ning* in all the public acts.

Nan-king has lost much of its ancient splendour: it had formerly a magnificent palace, no vestige of which is now to be seen; an observatory at present neglected, temples, tombs of the emperors, and other superb monuments, of which nothing remains but the remembrance. A third of the city is deserted, but the rest is well inhabited. Some quarters of it are extremely populous and full of business; particularly the manufacture of a species of cotton cloth, of which great quantities are imported into Europe under the name of *Nankin*. The streets are not so broad as those of Peking, they are, however, very beautiful, well paved, and bordered with rich shops.

In this city resides one of those great mandarins called *Tsong-gtou*, who takes cognizance of all important affairs, not only of both the governments of the province, but also of those of the province of Kiang-si. The Tartars have a numerous garrison here, commanded by a general of their own nation; and they occupy a quarter of the city, separated from the rest by a plain wall.

The palaces of the mandarins, whether Chinese or Tartars, are in this city neither larger nor better built than those in the capital cities of other provinces. Here are no public edifices corresponding to the reputation of so celebrated a city, excepting its gates, which are very beautiful, and some temples, among which is the famous porcelain tower. It is 200 feet high, and divided into nine stories by plain boards within, and without by cornices and small projections covered with green varnished tiles. There is an ascent of 40 steps to the first story; between each of the others there are 21.

The breadth and depth of the river Yang-tse-kiang formerly rendered the port of Nan-king very commodious; but at present large barks, or rather Chinese junks, never enter it: whether it be that it is shut up by sand banks, or that the entrance of it has been forbid, in order that navigators may insensibly lose all knowledge of it.

In the months of April and May a great number of excellent fish are caught in this river near the city, which are sent to court; they are covered with ice, and transported in that manner by barks kept entirely on purpose. Although this city is more than 200 leagues from Peking, these boats make such expedition, that

Nan-king || Napier.

that they arrive there in eight or nine days. This city, though the capital of the province, has under its particular jurisdiction only eight cities of the third class. The number of its inhabitants is said to be 1,000,000. without comprehending the garrison of 40,000 men. E. Long. 119. 24. N. Lat. 32. 46.

NANSIO, an island of the Archipelago, a little to the north of the island of Santorino, 16 miles in circumference; but has no harbour. The mountains are nothing but bare rocks, and there are not springs sufficient to water the fields. There is a vast number of partridges, whose eggs they destroy every year to preserve the corn, and yet vast numbers of them are always produced. The ruins of the temple of Apollo are yet to be seen, and consist chiefly of marble columns. E. Long. 26. 20. N. Lat. 36. 15.

NANTES, an ancient, rich, and very considerable town of France, in the department of Lower Loire, containing 73,879 inhabitants in 1800. It is situated on the north side of the Loire, about 40 miles from its mouth, at the confluence of the Erdre. It is the chief place of the department, the see of a bishop, and the seat of several tribunals. The atmosphere is pure, and the surrounding country is rich and beautiful. Nantes is a town of extensive trade. Vessels under 100 tons ascend to the city; those above that size discharge their cargoes at Paimboeuf, 25 miles below, and have them conveyed up in boats. The manufactures are cordage, canvas, linen, calico, leather, refined sugar, bottle-glass, &c. By the Loire, this town has an extensive communication with the interior of France; and supplies Orleans and other towns with foreign commodities. The Spaniards trade here in wine, fine wool, iron, silk, oil, oranges, and lemons; and they carry back cloth, stuffs, corn, and hard ware. The Dutch send salt fish, and all sorts of spices; and in return have wine and brandy. The Swedes bring copper; and the English, lead, tin, &c. It was in this place that Henry IV. promulgated the famous edict in 1598, called the *Edict of Nantes*, and which was revoked in 1685. Nantes was anciently, like almost every considerable city in Europe, very strongly fortified. Peter de Dreux, one of the dukes of Bretagne, surrounded it with walls, which have only been demolished within these few years. The bridge is an object of curiosity. It is near a mile and a half in length, being continued across all the little islands in the Loire, from north to south. W. Long. 1. 45. N. Lat. 47. 13.

NANTWICH. See NAMPTWICH.

NAPÆA, a genus of plants belonging to the polyadelphia class; and in the natural method ranking under the 37th order, *Columniferæ*. See BOTANY *Index*.

NAPHTHA, an inflammable substance of the bituminous kind. See CHEMISTRY and MINERALOGY.

NAPHTHALI, or NEPHTHALI (Josh. xix.), one of the tribes of Israel; having Zabulon on the south, Asher on the west, the Jordan on the east, and on the north Antilibanus.

NAPIER, JOHN, baron of Merchiston in Scotland, inventor of the logarithms, was the eldest son of Sir Archibald Napier of Merchiston, and born in the year 1550. Having given early discoveries of great natural parts, his father was careful to have them cultivated by a liberal education. After going through the ordinary courses of philosophy at the university of St Andrew's, he made the tour of France, Italy, and Germany. Upon his return to his native country, his literature and other fine accomplishments soon rendered him conspicuous, and might have raised him to the highest offices of the state: but declining all civil employments, and the bustle of the court, he retired from the world to pursue literary researches, in which he made an uncommon progress, so as to have favoured mankind with sundry useful discoveries. He applied himself chiefly to the study of mathematics; but at the same time did not neglect that of the Holy Scriptures. In both these he hath discovered the most extensive knowledge and profound penetration. His essay upon the book of the Apocalypse, indicates the most acute investigation, and an uncommon strength of judgment; though time hath discovered, that his calculations concerning particular events hath proceeded upon fallacious data. This work has been printed abroad in several languages; particularly in French at Rochelle in the year 1593, 8vo, announced in the title, as revised by himself. Nothing, says Lord Buchan, could be more agreeable to the Rochellers or to the Huguenots of France at this time, than the author's annunciation of the pope as antichrist, which in this book he has endeavoured to set forth with much zeal and erudition. But what has principally rendered his name famous, was his great and fortunate discovery of logarithms in trigonometry, by which the ease and expedition in calculation have so wonderfully assisted the science of astronomy and the arts of practical geometry and navigation. That he had begun about the year 1593 the train of inquiry which led him to that great achievement in arithmetic, appears from a letter to Crugerus from Kepler in the year 1624; wherein, mentioning the *Canon Mirificus*, he writes thus; "Nihil autem supra Neperianam rationem esse puto: etsi Scotus quidem literis ad Tychonem, anno 1564, scriptis jam spem fecit Canonis illius mirifici;" which allusion agrees with the idle story mentioned by Wood in his *Athenæ Oxon.* and explains it in a way perfectly consonant to the rights of Napier as the inventor. Napier

When Napier had communicated to Mr Henry Briggs, mathematical professor in Gresham college, his wonderful canon for the logarithms, that learned professor set himself to apply the rules in his *Imitatio Nepeirea;* and in a letter to Archbishop Usher in the year 1615, he writes thus: "Napier, baron of Merchiston, hath set my head and hands at work with his new and admirable logarithms. I hope to see him this summer, if it please God; for I never saw a book which pleased me better, and made me more wonder." The following passage from the life of Lilly the astrologer is quoted by Lord Buchan, as giving a picturesque view of the meeting betwixt Briggs and the inventor of the logarithms at Merchiston near Edinburgh. "I will acquaint you (says Lilly) with one memorable story related unto me by John Marr, an excellent mathematician and geometrician, whom I conceive you remember. He was servant to King James I. and Charles I. When Merchiston first published his logarithms, Mr Briggs, then reader of the astronomy lectures at Gresham college in London, was so much surprised with admiration of them, that he could have no quietness in himself until he had seen that noble person whose

Napier. whose only invention they were: he acquaints John Marr therewith, who went into Scotland before Mr Briggs, purposely to be there when these two so learned persons should meet. Mr Briggs appoints a certain day when to meet at Edinburgh; but failing thereof, Merchiston was fearful he would not come. It happened one day as John Marr and the baron Napier were speaking of Mr Briggs; 'Ah, John (said Merchiston), Mr Briggs will not come.' At the very instant one knocks at the gate: John Marr hasted down, and it proved to be Mr Briggs to his great contentment. He brings Mr Briggs up to the baron's chamber, where almost one quarter of an hour was spent, each beholding the other with admiration before one word was spoken. At last Mr Briggs began; 'Sir, I have undertaken this long journey purposely to see your person, and to know by what engine of wit or ingenuity you came first to think of this most excellent help into astronomy, viz. the logarithms; but, Sir, being by you found out, I wonder nobody else found it out before, when now being known it appears so easy.' He was nobly entertained by Baron Napier; and every summer after that, during the laird's being alive, this venerable man, Mr Briggs, went purposely to Scotland to visit him*."

* *Earl of Buchan's Account of the Writings and Inventions of Napier of Merchiston.*

There is a passage in the life of Tycho Brahe by Gassendi, which may mislead an attentive reader to suppose that Napier's method had been explored by Herwart at Hoenburg: It is in Gassendi's Observations on a Letter from Tycho to Herwart of the last day of August 1599. "Dixit Hervartus nihil morari se solvendi cujusquam trianguli difficultatem; solere se enim multiplicationum, ac divisionum vice additiones solum, subtractiones 93 usurpare (quod ut fieri posset, docuit postmodum suo logarithmorum Canone Neperus)." But Herwart here alludes to this work afterwards published in the year 1610, which solves triangles by prostaphæresis; a mode totally different from that of the logarithms.

Kepler dedicated his *Ephemerides*, to Napier, which were published in the year 1617; and it appears from many passages in his letter about this time, that he held Napier to be the greatest man of his age in the particular department to which he applied his abilities. "And indeed (says our noble biographer), if we consider that Napier's discovery was not like those of Kepler or of Newton, connected with any analogies or coincidences which might have led him to it, but the fruit of unassisted reason and science, we shall be vindicated in placing him in one of the highest niches in the temple of Fame. Kepler had made many unsuccessful attempts to discover his canon for the periodic motions of the planets, and hit upon it at last, as he himself candidly owns, on the 15th of May 1618; and Newton applied the palpable tendency of heavy bodies to the earth to the system of the universe in general; but Napier sought out his admirable rules by a slow scientific progress, arising from the gradual evolution of truth."

The last literary exertion of this eminent person was the publication of his *Rabdology and Promptuary* in the year 1617, which he dedicated to the Chancellor Seton; and soon after died at Merchiston on the 3d of April O. S of the same year, in the 68th year of his age and 23d of his happy invention.—The particular titles of his works published are: 1. A plain discovery of the Revelation of St John. 2. *Mirifici ipsius canonis constructio et logarithmorum, ad naturales ipsorum numeros habitudines.* 3. *Appendix de alia atque præstantiore logarithmorum specie constituenda, in qua scilicet unitas logarithmus est.* 4. *Rhabdologiæ, seu numerationis per virgulas, libri duo.* 5, *Propositiones quædam eminentissimæ, ad triangula sphærica mira facultate resolvenda.* To which may be added, 6. His Letter to Anthony Bacon (the original of which is in the archbishop's library at Lambeth), entitled, "Secret inventions, profitable and necessary in these days for the defence of this island, and withstanding strangers enemies to God's truth and religion;" which the earl of Buchan has caused to be printed in the Appendix to his Account of Napier's Writings. This letter is dated June 2. 1596, about which time it appears the author had set himself to explore his logarithmic canon. Napier.

This eminent person was twice married. By his first wife, who was a daughter of Sir James Stirling of Keir, he had only one son named Archibald, who succeeded to the estate. By his second wife, a daughter of Sir James Chisholm of Cromlix, he had a numerous issue.—*Archibald Napier*, the only son of the first marriage, was a person of fine parts and learning. Having more a turn to public business than his father had, he was raised to be a privy counsellor by James VI. under whose reign he also held the offices of treasurer-depute, justice-clerk, and senator of the college of justice. By Charles I. he was raised to the peerage by the title of *Lord Napier*.

Napier's Rods, or *Bones*, an instrument invented by Baron Napier, whereby the multiplication and division of large numbers is much facilitated.

As to the Construction of Napier's Rods: Suppose the common table of multiplication to be made upon a plate of metal, ivory, or pasteboard, and then conceive the several columns (standing downwards from the digits on the head) to be cut asunder: and these are what we call *Napier's rods of multiplication*. But then there must be a good number of each; for as many times as any figure is in the multiplicand, so many rods of that species (i. e. with that figure on the top of it) must we have; though six rods of each species will be sufficient for any example in common affairs: there must be also as many rods of 0's.

But before we explain the way of using these rods, there is another thing to be known, viz. that the figures on every rod are written in an order different from that in the table. Thus the little square space or division in which the several products of every column are written, is divided into two parts by a line across from the upper angle on the right to the lower on the left; and if the product is a digit, it is set in the lower division; if it has two places, the first is set in the lower, and the second in the upper division; but the spaces on the top are not divided; also there is a rod of digits, not divided, which is called the *index rod*, and of this we need but one single rod. See the figure of all the different rods, and the index, separate from one another, in Plate CCCLXIX. fig. 1.

Multiplication by Napier's Rods. First lay down the index rod; then on the right of it set a rod, whose

Napier. top is the figure in the highest place of the multiplicand; next to this again, set the rod whose top is the next figure of the multiplicand; and so on in order to the first figure. Then is your multiplicand tabulated for all the nine digits; for in the same line of squares standing against every figure of the index rod, you have the product of that figure; and therefore you have no more to do but to transfer the products and sum them. But in taking out these products from the rods, the order in which the figures stand obliges you to a very easy and small addition; thus, begin to take out the figure in the lower part, or units place, of the square of the first rod on the right; add the figure on the upper part of this rod to that in the lower part of the next, and so on; which may be done as fast as you can look on them. To make this practice as clear as possible, take the following example.

Example: To multiply 4768 by 385. Having set the rods together for the number 4768 (fig. 2.) against 5 in the index, I find this number by adding according to the rule, - - 23840
Against 8, this number - - 38144
Against 3, this number - - 14304

Total product - - - 1835680

To make the use of the rods yet more regular and easy, they are kept in a flat square box, whose breadth is that of ten rods, and the length that of one rod, as thick as to hold six (or as many as you please), the capacity of the box being divided into ten cells, for the different species of rods. When the rods are put up in the box (each species in its own cell distinguished by the first figure of the rod set before it on the face of the box near the top), as much of every rod stands without the box as shows the first figure of that rod: also, upon one of the flat sides without and near the edge, upon the left hand, the index rod is fixed; and along the foot there is a small ledge; so that the rods when applied are laid upon this side, and supported by the ledge, which makes the practice very easy; but in case the multiplicand should have more than nine places, that upper face of the box may be made broader. Some make the rods with four different faces, and figures on each for different purposes.

Division by Napier's Rods. First tabulate your divisor; then you have it multiplied by all the digits, out of which you may choose such convenient divisors as will be next less to the figures in the dividend, and write the index answering in the quotient, and so continually till the work is done. Thus 2179788, divided by 6123, gives in the quotient 356.

Having tabulated the divisor 6123, you see that 6123 cannot be had in 2179; therefore take five places, and on the rods find a number that is equal or next less to 21797, which is 18369; that is, 3 times the divisor; wherefore set 3 in the quotient, and subtract 18369 from the figures above, and there will remain 3428; to which add 8, the next figure of the dividend, and seek again on the rods for it, or the next less, which you will find to be five times; therefore set 5 in the quotient, and subtract 30615 from 34288, and there will remain 3673; to which add 8, the last figure in the dividend, and finding it to be just six times the divisor, set six in the quotient.

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6123)2179788(356
     18369..
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      34288
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Napier, Naples.

NAPLES, a kingdom of Italy, comprehending the ancient countries of Samnium, Campania, Apulia, and Magna Græcia. It is bounded on all sides by the Mediterranean and Adriatic, except on the north east, where it terminates on the Ecclesiastical state. Its greatest length from south-east to north-west is about 280 English miles; and its breadth from north-east to south-west, from 96 to 120.

The ancient history of this country falls under the articles ROME and ITALY; the present state of it, as well as of the rest of Italy, is owing to the conquests of Charlemagne. When that monarch put an end to the kingdom of the Lombards, he obliged the dukes of Friuli, Spoletto, and Benevento, to acknowledge him as king of Italy; but allowed them to exercise the same power and authority which they had enjoyed before his conquest. Of these three dukedoms Benevento was by far the most powerful and extensive, as it comprehended almost all the present kingdom of Naples; that part of Farther Calabria beyond the rivers Savuto and Peto, a few maritime cities in Hither Calabria, with the city of Acripoli, and the promontory in its neighbourhood called *Capo di Licosa;* and lastly, the dukedoms of Gaeta, Naples, and Amalfi, which were very inconsiderable, and extended along the shore only about 100 miles, and were interrupted by the Gastaldate or county of Capua.

1 Extent of the duchy of Benevento.

2 Arechis duke of Benevento revolts from Charlemagne.

This flourishing and extensive dukedom was at this time governed by Arechis, who had married one of the daughters of the last king of the Lombards, and had submitted, and taken the oath of allegiance to the emperor Charles. However, a few years after, he renounced his allegiance to the Franks, declared himself an independent sovereign, and was acknowledged as such by all the inhabitants of his duchy. To strengthen himself against Pepin king of Italy, who resided at Ravenna, he enlarged and fortified the city of Benevento, and likewise built Salerno on the sea coast, surrounding it with a very strong and high wall. He engaged in several wars with the Greeks, whom he sometimes obliged to give him hostages; but having invaded the territories of the pope, whom Pepin could not assist, Charlemagne was prevailed on to return to Italy. Arechis, unable to oppose such a formidable enemy, sent his eldest son, Romuald, to Rome, with an offer of submission: but, at the instigation of the pope, Charles refused the offer, and detained his son prisoner; after which he ravaged the country, and made himself master of Capua. Other deputies, however, proved more successful; and, in the year 787, a peace was concluded on these conditions: That Arechis and the Beneventans should renew their allegiance to the Franks; that he should pay a yearly tribute to Pepin; deliver up all his treasure; and

giva

Naples. gave his son Grimoald and his daughter Adelgisa, with twelve others, as hostages for his fidelity: however, after many entreaties, Adelgisa was restored to her father.

3 Submits.

Charles had no sooner left Italy, than Arechis forgot all his engagements, and began to negociate with Irene, empress of Constantinople, and her son Constantine, for expelling the Franks out of Italy. For himself, he desired the honour of the patriciate, and the dukedom of Naples with all its dependencies; and, in return, promised to acknowledge the Greek emperor as his sovereign, and to live after the manner of the Greeks. He required, however, to be supported by a Greek army, and that his brother-in-law Adalgisus, son to Desiderius the last king of the Lombards, should be sent over into Italy, to raise a party among his countrymen. These conditions were readily accepted, on condition that Prince Romuald should be sent as an hostage; ambassadors were sent to Naples with the ensigns of the Patrician order, namely the mantle of cloth of gold, the sword, the comb, and the sandals: but before the ceremony could be performed, Prince Romuald died, and soon after him his father; whose death was supposed to have been hastened by that of his son.

4 Revolts a second time.

After the death of Arechis, the Beneventans sent a most submissive embassy to Charlemagne, entreating him to send them Grimoald, the late king's son, and only lawful heir to his crown; threatening at the same time to revolt if their prince was denied them. Charles readily granted their request, and allowed Grimoald to depart, after he had agreed to the following conditions, viz. That he should oblige the Lombards to shave their beards; that, in writings, and on money, the name of the king should be put before that of the prince; and that he should cause the walls of Salerno, Acerenza, and Consia, to be entirely abolished.—

5 Grimoald continues for some time faithful to the Franks.

The new king was received by his subjects with the utmost joy: and for some time continued faithful to his engagements, excepting only the last article, which he either neglected or eluded. So far, however, was he from assisting the Greeks, that he gave notice of their machinations to Pepin king of Italy; raised an army to oppose his uncle Adalgisus; and being joined by Hildebrand duke of Spoletto, and Vinigise the general of Pepin, he attacked the Greeks in Calabria soon after they had landed, entirely defeated and took his uncle prisoner, and, as is said, put him to a cruel death. Yet in a short time Grimoald contracted an alliance with the Greek emperor by marrying his niece Wanzia; and in the fifth year of his reign a war broke out between him and Pepin, which continued for twelve years; at the end of which time a truce was concluded. Grimoald survived this pacification only three years, and was succeeded by his treasurer Grimoald II. who submitted to Charlemagne after the death of Pepin; and from this time the Beneventans were looked upon as tributaries of the western emperors. As yet, however, the city of Naples did not own allegiance to the dukes of Benevento, but was held by the eastern emperors; and frequent wars took place between the Beneventans and Neapolitans. This happened to be the case when Grimoald II. ascended the throne. He concluded a peace with them; which, however, was of no long continuance; for Theodore, governor of Naples, having granted protections to Dauferius a noble Beneventan, who had been concerned in a conspiracy against his prince, Grimoald marched against the city of Naples, and invested it by sea and land. Theodore still refused to deliver up the traitor, and a general engagement both by land and sea was the consequence; in which the Neapolitans were defeated with so great slaughter, that the sea was stained with their blood for more than seven days. Theodore then consented to deliver up Dauferius, with 8000 crowns for the expence of the war; and Grimoald not only pardoned Dauferius, but received him into favour. The traitor, however, reflecting on the heinousness of his crime, was seized with remorse; and went a pilgrimage to the holy land, carrying a large stone in his mouth, by way of penance, which he never took out but at his meals. Naples

6 Is murdered, and succeeded by Sico.

In the year 821, Grimoald was murdered by Radelchis count of Consia, and Sico Gastald of Acerenza, the latter of whom succeeded to the dukedom of Benevento. Radelchis being soon after seized with remorse, became a monk; while Sico associated his son Sicardo with him in the government; and both, being of an ambitious and restless disposition, sought a pretence for attacking the Neapolitans. This was soon found, and the city was invested by sea and land. The walls were furiously battered; and part of them being beat down, Sico prepared for a general assault. Stephen, at that time duke of Naples, pretended to submit; but, that he might prevent the city from being pillaged, entreated Sico to put off his entry till the morning, and in the mean time sent out his mother and his two children as hostages. Sico consented to his request; but next morning found the breach built up, and the Neapolitans prepared for their defence. Exasperated at their perfidy, he renewed his attacks with vigour, but without any success; the besieged defending themselves with the utmost obstinacy. At last, perceiving that they should not be able to hold out much longer, they consented to a peace on the following conditions, viz. That the Neapolitans should pay an annual tribute to the princes of Benevento, and consent of the transporting of the body of St Januarius from his church without the walls of Naples to Benevento. These conditions being ratified, Sico returned with great honour to Benevento; but soon after renewed the war, under pretence that the Neapolitans had neglected to pay the stipulated sum; and hostilities continued till his death, which happened in 833.

7 Naples besieged by Sico;

8 and by his successor Sicardo.

Sico was succeeded in the government of Benevento by his son Sicardo, who had married the daughter of Dauferius; and being influenced by the evil counsels of Roffrid his wife's brother, oppressed his subjects to such a degree that they conspired against his life. He besieged Naples with a powerful army, and took possession of Acerra and Atella, both of which he fortified. But Bonus, the Neapolitan duke, defended himself so vigorously, that the Beneventans were obliged to retire, and even to abandon Acerra and Atella, the fortifications of which were immediately demolished. At last Sicardo agreed to a peace for five years, on the intercession of Lothaire, emperor and king of Italy; but his chief motive was thought to have been the fear of the Saracens, whom the duke of Naples had called over from Africa to his assistance; for no sooner were they

Naples.

they sent back than Sicardo attempted to delay the conclusion of the treaty; but the emperor interposing his authority, a peace was concluded in the year 836, after the war had continued, with very little intermission, for 16 years.

9 The Saracens called in by the duke of Naples.

Soon after the conclusion of this peace, the Saracens landed at Brindisi; and having made themselves masters of the place, ravaged all the neighbouring country. Sicardo marched against them with a numerous army; but the Saracens having dug a great number of ditches which they slightly covered over, found means to draw the Beneventans in among them, whereby they were repulsed with great loss. However, Sicardo, having reinforced his army, marched again to attack them; but the Saracens, despairing of success, pillaged and burnt Brindisi, and then retired with their booty, and a great many captives to Sicily. Sicardo, then, without any apparent provocation, attacked the city of Amalfi, levelled its walls with the ground, carried off all its wealth, and the body of its tutelar saint Triphomen. A great many of the inhabitants were transported to Salerno; and by promoting alliances between the inhabitants of both places, he endeavoured to unite Amalfi to his own principality as firmly as possible.

During all these transactions, Sicardo had tyrannized over his subjects in such a manner, that at last he became intolerable. Among other acts of injustice, he imprisoned his own brother Siconolphus; compelled him to turn priest; and afterwards sent him bound to Tarento, where he caused him to be shut up in an old tower that had been built for a cistern. By such acts of tyranny his nobles were provoked to conspire against him; and in the year 839 he was murdered in his tent.

10 Sicardo murdered by R delchis which brings on a civil war.

On the death of Sicardo, Radelchis, his secretary or treasurer, was unanimously elected prince of Benevento; but Siconolphus, the last king's brother, having regained his liberty, formed a great party against the new prince. Radelchis did not fail to oppose him with a formidable army; and a most ruinous civil war ensued. Both parties by turns called in the Saracens; and these treacherous allies acted sometimes against one, and sometimes against the other; or, turned their arms against both, as seemed most suitable to their own interest. Thus the war continued with the utmost animosity for 12 years, during which time the principality was almost entirely ruined; till at last the emperor Lewis interposed, and obliged the competitors to agree to a partition of the principality. By this treaty, Radelchis promised to acknowledge Siconolphus and his successors as lawful princes of the principality of Salerno, which was declared to contain Tarento, Latiano, Cassano, Cossenzo, Laino, Lucadia, Consia, Montella, Rota, Salerno, Sarno, Ciraterium, Furculo, Capua, Feano, Sora, and the half of the Gastaldate of Acerenza, where it joins Latiano and Consia. The boundary betwixt Benevento and Capua was fixed at St Angelo ad Cerros; Alli Peregrini was made the boundary betwixt Benevento and Salerno, and Staffilo betwixt Benevento and Consia. The monasteries of Monte Cassino and St Vincent were declared to be immediately under the protection of the emperor: both princes stipulated that no hostilities should be committed by either against the subjects of each other; and promised to join their forces in order to drive out the Saracens. Soon after this pacification, however, both Radelchis and Siconolphus died; the former appointing his son Radelgarius, or Radelcar, to succeed him; and the latter leaving an infant son, Sico, to the care of his godfather, Peter.

11 The principality divided.

Naples.

12 Unsuccessful war with the Saracens.

The war with the Saracens proved very unsuccessful: neither the united efforts of the princes, nor the assistance of the emperor Lewis himself, being able to expel the infidels; and in 854, Adelgise the second son of Radelchis, who had now succeeded, on the death of his brother Radelcar, to the principality of Benevento, was obliged to pay them an annual subsidy. Two years after, Lando, count of Capua, revolted from the prince of Salerno, and could not be reduced. In the mean time, Sico, the lawful prince of Saleruo, had been poisoned by Count Lando, and the principality usurped by Ademarius, the son of Peter above mentioned; but in 861, Ademarius himself was seized and imprisoned by Gauferius, the son of Dauferius formerly mentioned. This was occasioned by his cruelty and rapaciousness, which entirely alienated the hearts of his subjects from him, and encouraged Gauferius to become the head of the conspirators. The Saracens in the mean time committed terrible ravages throughout the Beneventan territories; which at last obliged Adelgise to enter into an alliance with Gauferius, and both together sent a most humble embassy to the emperor Lewis, requesting him to take them under his protection. About the same time an embassy arrived from Constantinople, proposing a junction of the forces of the eastern and western empires against the infidels; upon which Lewis gave orders for assembling a formidable army. But in the mean time Adelgise fell off from his alliance, and made peace with the Saracens; nay, according to some, he encouraged them in their incursions, and it was at his desire that they invaded the duchy of Capua, and afterwards that of Naples, which they ravaged in a most barbarous manner. The Neapolitans, in conjunction with the duke of Spoletto and the count of Marsi, endeavoured to oppose them; but being defeated, the Saracens continued their ravages with redoubled fury, and retired to Bari, which was their capital city, with an immense booty.

In 866, Lewis arrived at Sora with his army: and having marched to Capua, was there joined by Landulph, the bishop and count, with a body of Capuans: but Landulph soon after persuading his countrymen to desert, Lewis marched against that city, which he took after a siege of three months, and almost totally destroyed. In the end of the year he was joined by Gauferius with his quota of troops, having ordered the eyes of Ardemarius to be put out in his absence. Lewis confirmed him in the principality, and marched with his army to Benevento, where Adelgise received him with great respect. Having reduced some inconsiderable places belonging to the Saracens, Lewis soon after invested Bari; but as the Saracens received continual supplies from their countrymen settled in Sicily, and besides were protected by the Neapolitans, he could not reduce the place till the year 871, though he had received considerable assistance from his brother Lotharius, and the Greek emperor had sent him a fleet of

Naples 200 sail. The expulsion of the Saracens was completed the same year by the taking of Tarento; after which the emperor returned with great glory to Benevento, resolving next to carry his arms into Sicily, and expel the infidels from thence also. But his future schemes of conquest were frustrated by a quarrel between him and Adelgise. The latter, pretending to have been insulted by the empress, and oppressed by the French, seized the emperor himself, and kept him prisoner for 40 days. His imprisonment would probably have been of much longer continuance, had not a body of Saracens arrived from Africa, who, being joined by such of their countrymen as had concealed themselves in Italy, laid siege to Salerno with an army of 30,000 men, ravaging the neighbouring country at the same time with the utmost barbarity. By this new invasion Adelgise was so much alarmed, that he set the emperor at liberty, but first obliged him to swear that he would not revenge the insult that had been offered him, and that he would never return to Benevento. Lewis having then joined his forces to those of the prince of Salerno, soon obliged the Saracens to raise the siege of Salerno; but though they were prevented from taking that city, they entirely destroyed the inhabitants of Calabria, leaving it, according to the expression of one of the historians of that time, "as desolate as it was at the flood."

13 They are at last expelled,

14 but soon return.

In the year 873, Lewis being absolved from his oath by the pope, went to Benevento, and was reconciled to Adelgise; but soon after this reconciliation he died, and the Saracens continued their ravages to such a degree that the inhabitants of Bari were constrained to deliver up their city to the Grecks. At the same time the Salernitans, Neapolitans, Cajetans, and Amalfitans, having made peace with the Saracens, were compelled to agree to their proposal of invading the territories of the Roman pontiff. His holiness exerted himself to the utmost, both with spiritual and temporal weapons, in order to defend his right; but was at last reduced to the necessity of becoming a tributary to the infidels, and promising to pay them a large sum annually.

15 The pope becomes their tributary.

In the mean time, all Italy was thrown into the greatest confusion by the death of Charles the Bald, who died of poison at Pavia, as he was coming to the pope's assistance. Sergius duke of Naples continued a firm friend to the infidels; nor could he be detached from their interests even by the thunder of a papal excommunication: but unluckily happening to fall into the hands of his brother Athanasius bishop of Naples, the zeal of that prelate prompted him to put out his eyes, and send him a close prisoner to Rome; for which the highest encomiums were bestowed on him by the holy father.

In 876, Adelgise was murdered by two of his nephews; one of whom, by name *Gaideris*, seized the principality. About the same time Landulph bishop of Capua dying, a civil war ensued among his children, though their father's dominions had been divided among them according to his will. The princes of Salerno and Benevento, the duke of Spoletto, and Gregory the Greek governor of Bari and Otranto, took different sides in the quarrel, as they thought most proper; and to complete the confusion, the new bishop was expelled, and his brother, though a layman, chosen to that office, and even consecrated by the pope, who wrote to Ganferius, forbidding him to attack Capua under pain of excommunication. But though Ganferius was, in general, obedient to the pope's commands, he proved refractory in this particular, and laid siege to Capua for two years successively. Naples.

Thus the Capuan territories were reduced to the most miserable situation; being obliged to maintain at the same time the armies of the prince of Benevento and the duke of Spoletto. The Saracens, in the mean time, took the opportunity of strengthening themselves in Italy; and Athanasius, notwithstanding the great commendations he had received from the pope for putting out his brother's eyes, consented to enter into an alliance with them, in conjunction with whom he ravaged the territories of the pope, as well as those of Benevento and Spoletto, plundering all the churches, monasteries, towns, and villages, through which they passed. At the same time the prince of Salerno was obliged to grant them a settlement in the neighbourhood of his capital; the duke of Gaeta invited them to his assistance, being oppressed by the count of Capua; and even the pope himself was obliged to make peace with them, and to grant them a settlement on the north side of the Carigliano, where they fortified themselves, and continued for more than 40 years.

To put a stop to the confusion which reigned in Italy, the pope now thought proper to restore the bishop of Capua, who had been expelled, but allowed his brother to reside in the city, and govern one half of the diocese; but notwithstanding this partition, the civil dissensions continued with the utmost violence, the nearest relations murdering or banishing each other, according as the fortune of the one or the other prevailed. Athanasius, notwithstanding all the pope's remonstrances, continued his alliance with the Saracens; in conjunction with whom he ravaged the territory of Benevento, and fomented the divisions in Capua, in hopes of being able to make a conquest of it. At last his holiness thought proper to issue a sentence of excommunication against him: but this attached him to the Saracens more than ever: insomuch that he sent to Suchaim, king of the Saracens in Sicily, desiring him to come over and command a great body of his countrymen who had settled at the foot of Mount Vesuvius. Suchaim accepted the invitation, and immediately turned his arms against Athanasius; allowing his troops to live at discretion in the territory of Naples, where they ravished the women, and plundered the inhabitants. These calamities were, by the superstitious Neapolitans, imagined to be a consequence of the sentence of excommunication; and therefore they used their utmost endeavours to persuade the prelate to conclude a league with some Christian prince, and renounce all connexion with the infidels. In this they at last proved successful, and Athanasius concluded an alliance with Gnaimarius prince of Salerno; in consequence of which the Saracens were obliged to quit the Neapolitan territories, and retire to Agropoli. Athanasius then directed his force against Capua, of which he made himself master in the year 882. The Saracens, however, still continued their incursions, and ravaged several provinces in such a manner, that they became entirely desolate.

These confusions continued for a long time; during which

Naples. which the Greeks found an opportunity of making themselves masters of Benevento, and well nigh became masters also of Salerno; but in this they failed through the treachery of the bishop, and in the year 896 they were totally expelled by the bishop, four years after they had become masters of it. In 915 the Saracens received such an overthrow at Carigliano, that scarce one of them remained. However, a new body soon arrived from Africa, and infested the sea coasts for some time longer. A war also ensued between Landulph and the Greeks; which concluded disadvantageously for the former, who was obliged to submit to the emperor of Constantinople in 943.

16 The Saracens almost entirely cut off.

In 961, Otho the Great, king of Germany, invaded Italy with a powerful army against Berengarius III. and, marching to Rome, received the imperial crown from the hands of the pope. In 964, he erected Capua into a principality, received homage from the other princes of Lombardy, and formed a design of recovering Puglia and Calabria from the Greeks. But in this last scheme he failed; and after various hostilities a treaty was concluded, and the young princess Theophania married to Otho's son, afterwards emperor.

All this time the Saracens continued their incursions; and the Greeks had gained ground so much, that they were now in possession of two-thirds of the present kingdom of Naples; but in the year 1002 or 1003, the Normans first began to be remarkable in Italy. They had, about a century before, embraced Christianity, and become very zealous in all the superstitions which were then practised. They were particularly zealous in visiting sacred places, especially Rome, and the holy sepulchre at Jerusalem; and being naturally of a very martial disposition, they forced through great bodies of Greeks and Saracens who opposed their passage. About this time 40, or, as others write, 100, of these Normans, returning from Jerusalem by sea, landed at Salerno in the habit of pilgrims, where they were honourably received by Guaimarius. During their residence at Salerno, a great body of Saracens landed, and invested the city. Guaimarius, not being in a condition to oppose the invaders by force, was preparing to pay them a large sum of money, which they demanded when the Normans proposed to attack them; and, having got arms and horses from the prince, they engaged the infidels with such fury and bravery, that they entirely defeated them, and obliged them to fly to their ships. By this complete victory Guaimarius was filled with such admiration of the valour of these strangers, that he entreated them to remain in his country; offering them lands, and the most honourable employments: but not being able to prevail with them to stay in Italy, or even accept of his presents; at their departure he sent some ambassadors with them to Normandy, in vessels loaded with exquisite fruits, rich furniture for horses, &c. in order to allure the valiant Normans to leave their own country. This kind invitation encouraged a Norman chief, named *Osmond Drengot*, to settle in Italy about the year 1015; having killed another lord in a duel, which obliged him to leave his own country, in order to avoid the resentment of his sovereign, Robert duke of Normandy. In the mean time, the city of Bari had revolted from the Greeks, and chosen one Mello for their leader, whose wife and children happened soon after to fall into the hands of their enemies, and were sent prisoners to Constantinople. No sooner, therefore, did Mello hear of the arrival of these adventurers, than he engaged them to assist him; and having drawn together a considerable army, defeated the Greeks with great slaughter, and obliged them to abandon their camp. In this engagement the Normans distinguished themselves by their bravery; and the news of their success soon brought from Normandy an innumerable multitude of their countrymen, with their wives and children. By this reinforcement, Mello gained two other victories, took a great many towns, and obliged the Greeks to abandon a large territory; but, in 1019, they were utterly defeated, and every thing recovered by the Greeks. The Greek general, Bajanus, continued to go on with such surprising success, that he almost entirely re-established the affairs of his countrymen in Italy, and made a distinct province of the western part of Puglia, which he called *Capatanata*, and which to this day retains the name of *Capitanata*. His great progress at last alarmed the emperors of Germany; and, in 1027, Pandulphus prince of Capua made himself master of Naples; but was obliged, three years afterwards, to leave it, by the Normans, who built the city of Aversa, which was now erected into a county. In consequence of this piece of good fortune, great numbers of Norman adventurers migrated into Italy; among whom were William, Drogo, and Umbert, three of the sons of Tancred duke of Hautville; from whose posterity those princes were descended, who first conquered the island of Sicily from the Saracens, and formed the present kingdom of Naples.

17 The Normans first known in Italy.

Naples. 18 They return and defeat the Greeks.

19 but are at last defeated by them.

In 1040, the Greek emperor Michael Palcologus, in order to secure the affection of his fickle subjects, undertook the conquest of Italy from the Saracens, and for that purpose sent a general named *Michael Maniacus* into Sicily. This commander, hearing of the great reputation of the Normans, sent to Guaimarius, prince of Salerno, entreating him to grant him some of those warriors. His request was most willingly hearkened to by the prince of Salerno, who, to encourage the Normans to engage in the expedition, promised them some additional rewards besides the emperor's pay. William, Drogo, and Umbert, accordingly marched from Salerno with 300 of their countrymen; and, passing over into Sicily, distinguished themselves most remarkably in the conquest of that island. Maniacus acknowledged, that the recovery of Messina was chiefly owing to their valour; and William with his Normans gained a complete victory over the Saracens before Syracuse, where he killed the governor of the city in single combat. Maniacus made himself master of Syracuse, and almost entirely reduced the whole island; but, being accused of treason, was next year carried prisoner to Constantinople. His successor Doecanus, being a man of no abilities, quickly lost the whole island except Messina, and treated his Norman auxiliaries with the utmost contempt. He would not allow them any share of the booty; and even caused one Ardoin, a noble Lombard, and associate and interpreter of the Normans, to be whipped round the camp, because he refused to part with the horse of a Saracen whom he had slain in single combat. The consequences of this tyrannical behaviour were very fatal to the Greeks.

20 The Normans pass over into Sicily.

Naples. Grecks. Ardoin soon after obtained leave to return to Italy under a pretence of a vow, and all the Normans embarked at night along with him; but instead of going to Rome, Ardoin went immediately to Aversa, where he persuaded Count Rainulphus, sovereign of that province, to join with him in the design he had formed of attacking the Greek provinces in Italy, which he showed him would be an easy conquest, as the inhabitants submitted with great reluctance to the Greeks, and the provinces were at that time almost entirely defenceless. Rainulphus approved of the scheme, and raised 300 soldiers, whom he sent under 12 officers to join the other Normans under the sons of Tancred; and made an agreement with Ardoin, that the
21 Their conquest. conquests should be equally divided among the chief leaders. Their first enterprise was the reduction of Melfis, one of the strongest cities in Puglia, which presently surrendered; and they increased its fortifications so much, that it thenceforth became impregnable. Soon after this they made themselves masters of Venosa, Ascoli, and Lavello, with very little opposition. Doceanus, alarmed with the rapidity of their conquests, immediately left Sicily, and marched with his army into Puglia, where he attacked the invaders near the river Oliviento; but after a fierce engagement, he was obliged to retire with considerable loss. The Greeks were soon after defeated a second time at Cannæ; and in a third engagement, which happened near the river Ofanto, the army of Doceanus was entirely routed, and he himself obliged to fly to Bari. On this bad success Doceanus was ordered to return to his command in Sicily, and another general was sent with an army into Puglia. This new commander, however, had no better success than his predecessor; for his army was entirely defeated in an engagement with the Normans, and he himself taken prisoner. Atenulphus, brother to one of the princes of Benevento on whom the Normans had conferred the chief command, set at liberty the captive general without consulting them, on receiving from him a considerable sum of money. With this the Normans were so much displeased that they deprived Atenulphus of his command, and bestowed it on Argyrus son to the late Mello, who had escaped from Constantinople, and now assumed the title of *duke and prince of Italy*. Before this time also Maniacus, whom we have formerly mentioned, had returned to Italy; and to strike the greater terror into the revolted cities, had executed a number of people of all ages and sexes with great inhumanity. Soon after this Maniacus openly rebelled against the Greek emperor Constantinus, and prevailed upon his own army to proclaim him emperor, beginning hostilities immediately against the Greek cities. Argyrus at the same time took Giovenazzo and besieged Trani, and soon after besieged Maniacus himself in Tarento; but he, being afraid of falling into the hands of the Normans, fled to Otranto, and from thence to Bulgaria, where being entirely defeated by one of the emperor's generals, he was taken prisoner, and had his head struck off.

The Normans having now conquered the greatest part of Puglia, proceeded to make a division of their conquest, in which, after each commander had got his proper share, the city of Melfis was left common to all, and appropriated as a place for assembling to consult about the most important affairs of the nation. Argyrus alone was neglected in this division; but he, having gained the favour of the emperor by expelling the rebel Maniacus from Italy, was by him created duke of Bari, on purpose to check the power of the Normans, with the title of *prince and duke of Puglia*. The Normans, however, were too powerful to be much awed by Argyrus, and behaved with great insolence to the neighbouring princes; but as they could not be expelled by force, and were confirmed in their conquests by Henry II. emperor of Germany in 1047, the Greek emperor attempted to get rid of them, by sending Argyrus with large sums of money to bribe them to enter into his service against the Persians. But they, perceiving the snare, replied that they were resolved not to leave Italy unless they were expelled by force: upon which Argyrus made use of the same money in bribing
22 Great numbers of them massacred. the Puglians to assassinate these invaders. This brought on a massacre, in which greater numbers of Normans perished than had fallen in all the late wars. Argyrus attempted to take advantage of the confusion produced by this massacre, but was defeated; after which he had recourse to Pope Leo, beseeching him to deliver Italy from these cruel tyrants: but this scheme proved still more unsuccessful than the others had been; for the pope himself was defeated and taken prisoner; and, in
23 They are confirmed by the Pope in all their conquests. consequence of the respect showed him by the Normans, granted them, as a fief of the holy see, all the conquests they had made or should make in Calabria and Sicily.

Soon after this, the Norman power became extremely formidable; the famous Robert Guiscard ascended the throne in 1056. He made great progress in the conquest of Calabria, and reduced most of the cities which held out for the Greeks in these parts. About the same time the counts of Capua were expelled from their territory; and the abbot Desiderius mentions his having seen the children of Landulphus V. the last count, going about as vagabonds, and begging for their support. The pope alarmed by these conquests, excommunicated the Normans in wholesale, pretending that they had seized some of the territories belonging to the church; but by the pretended submission of Robert, he not only was persuaded to take off the sentence of excommunication, but to invest him with the provinces of Apulia, Calabria, and Sicily. After this, he continued the war against the Greeks with
24 Sicily conquered by Robert Guiscard. great success. In 1071, in conjunction with his brother Roger, he conquered the island of Sicily, and gave the investiture of the whole island to him with the title of *count*, reserving to himself only the half of Palermo, Messina, and the valley of Demona. The like success attended his arms against Salerno in 1074; but after this, having unadvisedly taken some places from the pope, he again fell under the sentence of excommunication; yet he was reconciled to him in 1080, and received a second time the investiture of all his dominions. The next year he undertook an expedition against the Greeks; and though the emperor was assisted by a Venetian fleet, Robert made himself master of the island of Corfu, reduced Durazzo, and great part of Romania; insomuch that by the success of his arms, and his near approach to Constantinople, he struck an universal terror among the Greeks. But while Robert was thus extending his conquests, he was

alarmed

Naples. alarmed by the news of a formidable rebellion in Italy, and that the emperor Henry had taken the city of Rome, and closely shut up the pope in the castle of St Angelo. Robert, therefore, leaving the command of the army to his son Boemund, returned to Italy, where he immediately dispersed the rebels, and released the pope, while his son gained a considerable victory over the Greeks. After this Robert made great preparations for another expedition into Greece, in order to second his son Boemund. Alexius Comnenus, who was about this time declared emperor by the Greek army, being assisted by the Venetian fleet, endeavoured to oppose his passage; but was entirely defeated, with the loss of a great many galleys. But a final stop was now put to his enterprises by his death, which happened in the island of Corfu in 1085.

Though the power of the Normans was thus thoroughly established in Italy and Sicily, and though the prince of Benevento was in 1130 invested by the pope with the title of king of Sicily, yet by reason of the civil dissensions which took place among themselves, and the general confusion which reigned in Italy in those ages, they were obliged, notwithstanding all
25 And by the emperor of Germany. their valour, to submit to the emperor in 1195. By him the Sicilians were treated with so great cruelty, that the empress Constantia was induced to conspire against him in 1197, took him prisoner, and released him only on condition of his sending off his army immediately for the Holy Land. This was complied with; but the emperor did not long survive the reconciliation, being poisoned, as was supposed, by order of the empress.

In 1254 the pope claimed the kingdom as a fief devolved on the church in consequence of a sentence of deposition pronounced against King Frederick at the council of Lyons; and, in 1263, the kingdom was, in consequence of this right, conferred on Charles count of Anjou. After much contention and bloodshed, the
26 The French become masters of Sicily and Naples. French thus became masters of Sicily and Naples. Their government was insupportably tyrannical; and at the same time the haughtiness of their king so provoked the pope, that he resolved to humble him.—Charles had resolved on an expedition against Constantinople; and for this purpose had fitted out a fleet of 100 galleys, 30 large ships, 200 transports, besides many other smaller vessels, on board of which he intended to embark 10,000 horse, and a numerous army of foot. This formidable armament greatly alarmed the emperor Michael Paleologus; for which reason he entered into a negotiation with John di Procida, a noble Salernitan, lord of the isle of Procida in the bay of Naples, who had formed a scheme for a general revolt in the island of Sicily. John, though a nobleman, was also a physician, and had been counsellor to two former princes, and even to King Charles himself; but being stripped of his estate by the king under pretence of treason, and his wife being debauched by the French, he retired to Constantia queen of Arragon, where he was created a baron of the kingdom of Valencia, by her husband King Peter, and lord of Luxen, Benizzano, and Palma. As he was greatly exasperated against the French, he employed many spies both in Puglia and Sicily; and being informed that the Sicilians were totally disaffected to the French, he came to the island in disguise, and concerted a plan with the most powerful of the malecontents for a revolution in favour of Constantia, though she derived her right only as being the daughter of a former usurper named *Manfred*. Procida then set out for Constantinople, where in some private conferences with the emperor, he persuaded him, that the most probable means of defeating Charles's scheme was by assisting the Spaniards and Sicilian malecontents Paleologus accordingly granted him a large sum of money, and on his departure sent one of his secretaries along with him, who, landing in Sicily, had a conference with the chief conspirators. John, having received letters from them, disguised himself in the habit of a Franciscan, and went to Suriano in the neighbourhood of Rome. As he well knew the enmity which subsisted between the pope and King Charles, he disclosed his design to his holiness; who readily entered into his measures, wrote to Peter to hasten his armament, promising him the investiture of the island as soon as he had taken possession of it; and, by refusing the assistance he had promised to Charles, obliged him for the present to delay his expedition In the beginning of the year 1280, Procida returned to Arragon, and by showing the letters from the pope and Sicilian barons, prevailed on Peter to embark in his design, by assuring him of the assistance of Paleologus. This king of Arragon accordingly prepared a formidable fleet under pretence of invading Africa, and is even said to have received 20,000 ducats from Charles, in order to assist him in his preparations. Naples.

But while John went on thus successfully with his scheme, all his measures were in danger of being broke by the death of Pope Nicholas. The new pope, Martin IV. was entirely in the interest of Charles, on whom, in 1281, he conferred the senatorial dignity of Rome. Procida, however, still resolved to prosecute his scheme; and, leaving Italy, had another conference with the conspirators in Sicily; after which, he again went to Constantinople, and obtained from Paleologus 30,000 ounces of gold, with which he immediately returned to Arragon. The death of Nicholas had damped the ardour of Peter; but, being urged with great earnestness by John, he again renewed his preparations; which alarmed the pope and the king of France. In consequence of this they sent a message to him, desiring to know against what Saracens he designed to employ his armament. In this particular Peter refused to satisfy them; upon which they earnestly counselled Charles to guard against an invasion: but he neglected their advice, being wholly intent on his eastern expedition, and encouraged by a revolt which had happened in Greece; and to facilitate his expedition, he prevailed on the pope to excommunicate the Greeks, on pretence that they had broken some of the articles of union concluded at the council of Lyons a few years before. Peter in the mean time continued his preparations with great diligence, intending to put to sea the following summer. Procida had returned to
27 They are massacred. Palermo, to wait for a favourable opportunity of putting his design in execution, which was soon afforded him by the French. On Easter Monday, March 30. 1282, the chief conspirators had assembled at Palermo; and, after dinner, both the Palermitans and French went in a grand procession to the church of Monreale, about three miles without the city. While they were sporting

Naples. sporting in the fields, a bride happened to pass by with her train, who being observed by one Drochettus, a Frenchman, he ran to her, and began to use her in a rude manner, under pretence of searching for concealed arms. A young Sicilian, exasperated at this affront stabbed him with his own sword; and a tumult ensuing, 200 French were immediately murdered. The enraged populace then ran to the city, crying out, "Let the French die, Let the French die;" and, without distinction of age or sex, slaughtered all of that nation they could find, even such as had fled to the churches. The conspirators then left Palermo, and excited the inhabitants to murder the French all over the island, excepting in Messina, which city at first refused to be concerned in the revolt. But, being invited by the Palermitans to throw off the French yoke, a few weeks after, the citizens in a tumultous manner destroyed some of the French; and pulling down the arms of King Charles, and erecting those of the city, chose one Baldwin for their governor, who saved the remaining French from the fury of the populace, and allowed them to transport themselves, with their wives and children to Italy. Eight thousand persons are said to have been murdered on this occasion.

Immediately after this massacre, the Sicilians offered their allegiance to the king of Arragon; who accepted of the invitation, and landed with his forces at Trapani. From thence he went to Palermo, where he was crowned king of Sicily with great solemnity, and Charles left the island with precipitation. The day after he landed his army in Italy, the Arragonian fleet arrived, took 29 of his galleys, and the next day burnt 80 transports in presence of his army. Soon after this Charles sent an embassy to Peter, accusing him of perfidy, in invading his dominions in time of peace; and, according to some, challenged him at the same time to decide the matter by single combat. Others say that the challenge was given by Peter. Certain it is, however, that a challenge was given, and to appearance accepted: but Peter determined to employ much more effectual means in support of his pretensions than trusting to a duel; and therefore pushed on his operations most vigorously, while his adversary trifled away his time: and thus he at last became master of the contested kingdom; which, however, he did not long enjoy, dying about the end of the year 1285.

By his will, Peter left the kingdom of Arragon to his eldest son Alphonsus, and Sicily to Don James his other son, who was also to succeed to the kingdom of Arragon in case Alphonsus should die without male issue. Accordingly, Don James was solemnly crowned at Palermo the 2d of February 1286. In 1295, however, he deserted them, and tamely resigned up his right to Charles, son to him above mentioned, in a manner perhaps unparalleled. On his resignation the Sicilians conferred the crown upon his brother Don Frederic: after which the war continued with great violence till the year 1303, when a peace was concluded, and the kingdoms of Naples and Sicily formally disjoined; Frederic being allowed to keep the latter, under the name of *Trinacria*; and Charles being confirmed in the possession of the former, which he quietly enjoyed till his death in 1309.

28 The kingdoms of Naples and Sicily disjoined.

Naples continued to be governed by its own kings till the beginning of the 16th century, when the kings of France and Spain contended for the sovereignty of this country. Frederic, at that time king of Naples, resigned the sovereignty to Louis XII. on being created duke of Anjou, and receiving an annual pension of 30,000 ducats. But, in 1504, the French were entirely defeated by the Spaniards, and obliged to evacuate the kingdom; and the following year Louis renounced all pretensions to the crown, which from this time hath remained almost constantly in the hands of the Spaniards.

Naples.

29 The Spaniards become masters of Naples.

The government of the Spaniards proved no less oppressive to the Neapolitans than that of others had been. The kings of Spain set no bounds to their exactions, and of consequence the people were loaded with all manner of taxes; even the most indispensable necessaries of life not being exempted. In 1647, a new tax was laid on fruit; which the people looked upon as the most grievous oppression, the chief part of their subsistence, during the summer months, being fruit, which in the kingdom of Naples is very plentiful and delicious. The edict for collecting the new duty was no sooner published, than the people began to murmur in a tumultuous manner; and when the viceroy came abroad, they surrounded his coach, bawling out to have their grievances redressed. They were encouraged in their sedition, by the news that the citizens of Palermo had actually revolted on account of the imposition of new duties. The viceroy, therefore, apprehensive of greater disorders, began to think of taking off the tax; but those who farmed the tax having bribed some of his favourites, he was by their means persuaded not to abolish it. The indignation of the people, who had suspected his intention, was now greatly increased, especially as they were privately excited by several malecontents. The farmers of the revenue, and all those concerned in raising the taxes had incurred the hatred and detestation of the people particularly of Tommaso Aniello, commonly called *Massaniello of Amalfi*, a fisherman, whose wife, having been discovered in smuggling a small quantity of meal, was imprisoned, and condemned to pay a fine of 100 ducats.

30 A general revolt.

31 Account of Massaniello.

Massaniello, a few years before had come to Naples from Amalfi, where his father had been a fisherman. At this time he was about 24 years of age, and the father of four children. He was of a middle stature, and an agreeable aspect; was distinguished for his boldness, activity, and integrity; and had a great influence with his companions, by whom he was beloved and esteemed. As he was obliged even to sell his furniture to pay the heavy fine, he had conceived an implacable hatred against the farmers of the taxes, and was also moved with compassion for the miserable state of the city and kingdom. He therefore formed a design, with some of his companions, to raise a tumult in the market place on the festival-day of the Carmelites, usually celebrated about the middle of July, when between 500 and 600 youths entertain the people by a mock fight; one half of them, in the character of Turks, defending a wooden castle, which is attacked and stormed by the other half in the character of Christians. Massaniello being appointed captain of one of these parties, and one Pione, who was privy to his design, commanding the other, for several weeks

Naples. before the festival they were very diligent in reviewing and training their followers, who were armed with sticks and reeds; but a small and unforeseen accident tempted them to begin their enterprise without waiting for the festival.

On the 7th of July a dispute happening in the market-place betwixt the tax-gatherers and some gardeners of Pozzuolo who had brought some figs into the city, whether the buyer or seller should pay the duty; after the tumult had continued several hours, Massaniello, who was present with his company, excited the mob to pillage the office built in the market for receiving the duty, and to drive away the officers with stones. The elect of the people, who, by deciding against the gardeners, had increased the tumult, ran to the palace, and informed the viceroy, who most imprudently neglected all means of putting a stop to the commotion. Massaniello, in the mean time, being joined by great numbers of people, ordered his young troop to set fire to all the offices for the taxes through the city; which command being executed with despatch, he then conducted them directly to the palace, where the viceroy, instead of ordering his Spanish and German guards to disperse them, encouraged their insolence by timidly granting their demands. As they rushed into the palace in a furious manner, he escaped by a private door, and endeavoured to save himself in *Castel del Ovo;* but being overtaken by the rioters in the streets, he was trampled upon by them, and pulled by the hair and whiskers. However, by throwing some handfuls of gold among them, he again escaped, and took sanctuary in a convent of Minims, where, being joined by the archbishop of Naples, Cardinal Filomarini, and several nobles, by their advice he signed a billet, by which he abolished all taxes upon provisions. As a means to quell the tumult, he likewise desired the cardinal to offer Massaniello a pension of 2400 crowns, who generously rejected the bribe; and declared, that if the viceroy would keep his word, he would find them obedient subjects.

It was now expected that the tumult would cease; but Massaniello, upon his return to the market-place, being joined by several malecontents, among whom were Genuino and one Peronne, who had formerly been a captain of the Sbirri, he was advised by them to order the houses of those concerned in raising the tax to be burned; which were accordingly in a few days reduced to ashes, with all their rich furniture. Massaniello being now absolute master of the whole city, and being joined by great numbers of people of desperate fortunes, he required the viceroy, who had retired to the *Castel Nuovo*, to abolish all the taxes, and to deliver up the writ of exemption granted by Charles V. This new demand greatly embarrassed the viceroy; but to appease the people, he drew up a false deed in letters of gold, and sent it to them by their favourite the duke of Matalone, who had before been in confinement. The fraud, however, being discovered, the duke was pulled from his horse and maltreated by the mob, and at length committed as a prisoner to Peronne. This accident, to the great joy of the viceroy, enraged the people against the nobility, several of whom they killed, burnt the houses of others, and threatened to extirpate them all. Massaniello, in the mean time, tattered and half naked commanded his followers, who Naples. were now well armed, and reckoned about 100,000 men, with a most absolute sway. He ate and slept little, gave his orders with great precision and judgement, appeared full of moderation, without ambition and interested views. But the duke of Matalone having procured his liberty by bribing Peronne, the viceroy imitated his example, and secretly corrupted Genuino to betray his chief. A conspiracy was accordingly formed against Massaniello by Matalone and Peronne; the duke, who was equally exasperated against the viceroy, proposing, that after his death his brother D. Joseph should head the rebels.

Massaniello in the mean time, by means of the cardinal archbishop, was negotiating a general peace and accommodation; but while both parties were assembling in the convent of the Carmelites, the banditti hired by Matalone made an unsuccessful attempt upon Massaniello's life. His followers immediately killed 150 of them. Peronne and D. Joseph being discovered to be concerned in the conspiracy, were likewise put to death, and the duke with great difficulty escaped. Massaniello by this conspiracy was rendered more suspicious and severe. He began to abuse his power by putting several persons to death upon slight pretences; and, to force the viceroy to an accommodation, he cut off all communication with the castles, which were unprovided with provision and ammunition.—The viceroy likewise being afraid lest the French should take advantage of the commotion, earnestly desired to agree to a treaty; which was accordingly concluded on the fifth day of the insurrection, by the mediation of the archbishop. By the treaty it was stipulated, that all duties imposed since the time of Charles V. should be abolished; that the writ of exemption granted by that emperor should be delivered to the people; that for the future no new taxes should be imposed; that the vote of the elect of the people should be equal to the votes of the nobility; than an act of oblivion should be granted for all that was past; and that the people should continue in arms under Massaniello till the ratification of the treaty by the king.

32 A treaty concluded between Massaniello and the viceroy.

By this treaty, no less than 10,000 persons who fattened upon the blood of the public were ruined.—The people, when it was solemnly published, manifested an extreme joy, believing they had now recovered all their ancient rights and privileges. Massaniello, at the desire of the viceroy, went to the palace to visit him, accompanied by the archbishop, who was obliged to threaten him with excommunication, before he would consent to lay aside his rags and assume a magnificent dress. He was received by the duke with the greatest demonstrations of respect and friendship, while the duchess entertained his wife, and presented her with a robe of cloth of silver, and some jewels.—The viceroy, to preserve some shadow of authority, appointed him captain-general; and at his departure made him a present of a golden chain of great value, which with great difficulty he was prevailed upon to accept; but yielded at length to the entreaties of the cardinal. Next day, in consequence of the commission granted him by the viceroy, he began to exercise all the functions of sovereign authority; and having caused a scaffold to be erected in one of the streets, and several

33 Massaniello appointed captain-general.

Naples. veral gibbets, he judged all crimes, whether civil or military, in the last resort; and ordered the guilty to be immediately put to death, which was the punishment he assigned to all offences. Though he neglected all forms of law, and even frequently judged by physiognomy, yet he is said not to have overlooked any criminal, or punished any innocent person.

His grandeur and prosperity were of very short continuance; for his mind becoming distracted and delirious for two or three days, he committed a great many mad and extravagant actions; and on the 18th of July
34 Is assassinated. he was assassinated with the consent of the viceroy.

The tumult did not end with the death of Massaniello: on the contrary, the people now expelled the Spaniards from most of the cities throughout the kingdom; and this general insurrection being the subject of discourse at Rome, the duke of Guise, who happened then to be at the pope's court, took the opportunity, at the instigation of his holiness, to offer his service to the Neapolitans against the Spaniards. The duke was prompted by his ambition to engage in this enterprise, especially as he himself had some distant pretensions to the crown. The Spaniards in the mean time made a vigorous attack on the city; but were repulsed by the people, who now formally renounced their allegiance to them. In a short time, however, their city being surprised by the new viceroy, the count d'Oniate, and the duke of Guise himself taken
35 The people return to their allegiance. prisoner, the people returned to their allegiance; and thus all the attempts of the French on Naples were frustrated. From that time the Spaniards continued in peaceable possession of the kingdom till the year 1707, when it was taken from them by Prince Eugene. It was formally ceded to the emperor by the treaty of Rastadt in 1713; but was recovered by the Spaniards in 1734, and a branch of the family of Spain has reigned there since that time. For a particular account of these revolutions, see the articles SPAIN and SICILY.

Naples, like the other states of Europe, has experienced many revolutions within the last thirty years. She took part in the alliance against France in 1793, but was little affected by the war till 1796, when the progress of the French arms in Italy induced her to conclude a peace. The continual encroachments of the French, however, made her take up arms again in concert with Austria in 1798; but her forces commanded by General Mack sustained repeated defeats, and the French gained possession of the capital. The king retired to Palermo in Sicily in December 1798, till the successes of Suwarrow compelled the French to withdraw their troops, after which he re-entered his capital in 1799. After the treaty of Luneville, Naples obtained peace from France on the condition of giving up the port of Otranto. In 1806 the king admitted some British and Russian troops into his dominions, and this was made a pretext by Bonaparte for dethroning him. The kingdom of Naples was given to Joseph Bonaparte, who retained it till he was promoted to the crown of Spain in 1808, when Naples was given to Joachim Murat. From this period Naples followed the fortunes of France, and furnished men and money for her wars. After the disasters of the Russian campaign, Murat who had received some insults from Bonaparte shook off his authority, and entering into terms with the allies obtained a recognition of his independence. In the beginning of 1814 he assisted the Austrians in overthrowing the French viceroy in Italy; but repenting of this course, or distrusting the intentions of the allies, he declared for Bonaparte when the latter returned to France in 1815. Fortune however did not favour him; he was defeated, and fled to France in May 1815. In a fit of rash enthusiasm he set out with a small band of 400 adventurers, landed in Naples in October, but instead of meeting with support was immediately taken and executed. Since that time Ferdinand IV. has had peaceable possession of the kingdom. Naples.

36 Climate, produce, &c. of Naples. The climate of Naples is extremely hot, especially in July, August, and September. In winter there is seldom any ice or snow, except on the mountains.—On account of its fertility, it is justly termed an earthly paradise; for it abounds with all sorts of grain, the finest fruit and garden productions of every kind, with rice, flax, oil, and wine, in the greatest plenty and perfection. It affords also saffron, manna, alum, vitriol, sulphur, rock crystal, marble, and several sorts of minerals, together with fine wool, and silk. The horses of this country are famous, and the flocks and herds very numerous. Besides these products, of which a considerable part is exported, there are manufactures of snuff, soap, and glass ware. Waistcoats, caps, stockings, and gloves, are also made of the hair or filaments of a shell fish, which are warmer than those of wool, and of a beautiful glossy green. In this kingdom likewise is found that called the *Phrygian stone*, or *pietra fungifera*, which, being laid in a damp shady place, will yield mushrooms, sometimes of a very large size, especially if the stone is sprinkled with hot water. See AGARICUS.

As to the mountains of this country, the principal are the Apennines, which traverse it from south to north; and Mount Vesuvius, which, as is well known, is a noted volcano, five Italian miles from Naples. The side of this mountain next the sea yields wine, particularly the two famed wines called *Vino Greco* and *Lachrymæ Christi*. One of the greatest inconveniences to which this kingdom is exposed is earthquakes, which the eruptions of Mount Vesuvius contribute, in some measure, to prevent. Another inconveniency, which, however, is common to it with other hot countries, is the great number of reptiles and insects, of which some are very poisonous.

37 Religion. With respect to religion, it is on a very bad footing here. The number of convents and monasteries is astonishing. It is said, the clergy and convents possess two thirds of the whole kingdom: nay, some maintain, that were the kingdom divided into five parts, four would be found in the hands of the church. Notwithstanding this power and influence of the clergy, they have not been able hitherto to get the inquisition established here. In the year 1731, measures were taken for lessening the number of convents; and lately the order of Jesuits hath been suppressed. The papal bulls cannot be made public without the king's permission; nor are Protestants compelled to kneel in the churches, or at meeting the host; and in Lent they can very easily procure flesh meat. In the year 1740, the Jews were allowed to settle in the kingdom during the term of 50 years, and several privileges were granted them during that period; at the expiration of which,

Naples

the grant was supposed to be renewed, unless they were expressly ordered to quit the country.

The king of Naples, or of the two Sicilies, is an hereditary monarch. The high colleges are, the council of state, the privy council, the treasury, the Sicily council, the council of war, &c. This kingdom is a papal fief; and the king, in acknowledgment of the pope's feudal right, sends him every year a white palfry, and a purse of 6000 ducats. The title of the king's eldest son is *prince of Calabria*. The number both of the high and low nobility in the kingdom of Naples is very great. "I am assured (says Dr Moore*) that the king of Naples counts among his subjects 100 persons with the title of prince, and a still greater with that of duke. Six or seven of these have estates which produce from 10 to 12 or 13,000l. a-year; a considerable number have fortunes of about half that value; and the annual revenue of many is not above 1000l. or 2000l. The inferior orders of the nobility are much poorer. Many counts and marquisses have not above 300l. or 400l. a-year of paternal estate; many have still less; and not a few enjoy the title without any estate whatever. These nobles, however, are excessively fond of splendour and show, which appears in the brilliancy of their equipages, the number of their attendants, the richness of their dress, and the grandeur of their titles. The finest carriages are painted, gilt, varnished, and lined, in a richer and more beautiful manner than has yet become fashionable either in England or in France. They are often drawn by six and sometimes by eight horses. Before the carriage, it is the mode to have two running footmen, and behind three or four servants in the richest liveries. The ladies and gentlemen within the coaches glitter in all the brilliancy of lace, embroidery, and jewels.—This finery is not confined to the persons within and without the coaches; it is extended to the horses, whose heads, manes, and tails, are ornamented with the rarest plumage, and set off with ribbons and artificial flowers."

* *View of Society, &c in Italy.*

The population of Naples in 1769 was 3,953,098; in 1783 it was 4,675,376, including 45,525 secular priests, 24,694 religious of the male sex, and 20,973 of the female. (Mentelle et Malte Brun.).

In the kingdom of Naples, the hereditary jurisdiction of the nobles over their vassals subsists in the full rigour of the feudal government. The peasants therefore are poor; and it depends entirely on the personal character of the master, whether their poverty be not the least of their grievances. As this power is too often abused, the importance of the nobility depends in a great measure on the favour of the king, who, under pretence of any offence, can confine them to their estates, or imprison them at pleasure. Unless this prince were so very impolitic as to disgust all the nobility at once, and so unite the whole body against him, he has little to fear from their resentment. Even in case of such an union, as the nobles have lost the affection of their vassals, what could they do in opposition to a standing army of 30,000 men, entirely devoted to the crown? The government of Naples, therefore, is in fact a despotic monarchy, though something like the form of a feudal constitution in its ancient purity is still kept up by the biennial summons of the general assembly. This convention, which consists of the nobility and commons, is called together every two years, to deliberate on the customary free gift to the crown. Naples.

The inhabitants of this country have at all times borne but an indifferent character among other nations. "From the few hints dropped by the classic authors, we collect that the ancient Neapolitans were a race of epicures, of a soft indolent turn, averse from martial exercises, passionately fond of theatrical amusements and music, expert in all the refined arts that administer to the caprices of luxury, extravagant in their expressions and gestures, and dupes to various sorts of superstition. If we make allowance for a quantity of northern blood which has joined the original Grecian stream, and imparted a roughness not yet worn off by the mildness of the climate, we shall find the modern Neapolitans very like the ancient.—Provisions being here plentiful and cheap, the lower class of people work but little. Their delight is to bask in the sun, and do nothing. Persons of a middle rank frequent places of public resort; and very few of any rank attend to their proper business with the zeal and activity we are wont to meet with in the professional men of colder countries. Gluttony is a predominant vice, while instances of ebriety are comparatively rare. In the female sex, the passion for finery is almost superior to every other; and, though chastity is not the characteristic virtue of the country, Mr Swinburne doubts * whether a Neapolitan woman would not nine times out of ten prefer a present to a lover. That furious jealousy for which the nation was once so remarkable, is now greatly abated. The breach of the conjugal vow sometimes occasions quarrels and assassinations among people of an inferior station; and in the metropolis, assassinations are often perpetrated from much less cogent motives. Of these vices, many are doubtless owing to that slavery and oppression under which they groan, and to a radical defect in the administration of justice, though the kingdom is divided into 12 provinces or jurisdictions.

* *Travels in the two Sicilies.*

NAPLES, anciently *Parthenope*, afterwards *Neapolis*, the capital of the kingdom of that name in Italy, lies in the province called *Terra de Lavora*, which is the richest and best inhabited of the whole kingdom, and comprehends a part of the ancient Campania Felix or the Happy. This city is fabled to owe its foundation to a Syren, and to have received its ancient name from its supernatural foundress. Whatever be its origin, it is the first for neatness, and the second for extent, of all the cities in Italy. It was formerly a place of strength; but its walls at present being of no real defence, its safety depends of course upon the force of its armies. It is most advantageously situated, having a delicious country on one side, and a noble bay of the Mediterranean on the other, with an excellent harbour. The circumference, including the suburbs, is said not to be less than 18 Italian miles, and the number of the inhabitants therein little less than 300,000. The houses are of stone, flat roofed, and generally lofty and uniform; but many of them have balconies, with lattice windows. The streets are well paved; but they are not lighted at night, and in the day time are disfigured, in many places, by stalls, on which provisions are exposed to sale. Here are a great number of fine churches, convents, fountains, and palaces of the nobility,

Naples. lity, many of whom constantly reside here. It is usual to walk on the tops of the houses in the evenings, to breathe the sweet cool air, after a hot sultry day. The climate here is so mild and warm, even in the winter, that plenty of green peasc, artichokes, asparagus, and other vegetables, may be had so early as the beginning of the new year, and even all the winter. This city swarms with monks and nuns of all sorts, to such a degree, that there are no less than 149 convents. There are also 34 poorhouses, 11 hospitals, 43 parish churches, and 70 other churches. The magnificence of many of the churches exceeds imagination. In a cloister of the Carthusian monastery is a crucifix, said to be done by Michael Angelo, of inimitable workmanship.

To repel hostile attempts by sea, which from its situation, maritime powers might be tempted to make, Naples has, to the west, the Castel del Ovo, a confused pile of ancient buildings, and some modern batteries. The rock upon which this fortress stands was originally called *Megara*, then *Lucullanum;* and was considered as a place of strength so early as the year 475. Along the line of the shore towards the east are some batteries on the points of land, the bastions of the arsenal, and above it the lofty wall of the Castel Nuovo. This last fortress has been the usual refuge of the sovereigns and viceroys in all civil wars and tumults; for which reason they have long fixed their residence near its walls. A blockhouse and batteries defend the mouth of the harbour, and at the eastern extremity of the town is the Torrione de Carmine, better known by the figure it made in Massaniello's rebellion than by its extent or military strength. The castle of St Elmo commands Naples in every direction, and is in reality calculated rather to annoy and awe the citizens than to defend them from foreign invaders. The city is indeed far from being secure against a bombardment; for the sea is so deep, that a large vessel may come up to the very mole in defiance of the blockhouse and batteries, &c. Pictures, statues, and antiquities, are not so common in Naples as might be expected in so great and ancient a city, many of the most valuable pieces having been sent to Spain by the viceroys. The bay is one of the finest in the world, being almost of a round figure, about 30 miles in diameter, and three parts of it sheltered with a noble circuit of woods and mountains. The city stands in the bosom of this bay, in as pleasant a situation, perhaps, as is in the world. Mr Keysler says, they reckon about 18,000 *donne libere*, or courtezans, in the city; and Dr Moore computes the number of *lazzaroni*, or blackguards at above 30,000. The greater part of these wretches have no dwelling houses, but sleep every night under porticos, piazzas, or any kind of shelter they can find. Those of them who have wives and children, live in the suburbs of Naples near Pausilippo, in huts, or in caverns or chambers dug out of that mountain. They are generally represented as a lazy, licentious, and turbulent set of people, as indeed by far the greater part of the rabble are, who prefer begging or robbing, or running errands, to any fixed and permanent employment. Yet there are in Naples some flourishing manufactures, particularly of silk stockings, soap, snuff-boxes of tortoise shells and the lava of Mount Vesuvius, tables, and ornamental furniture of marble. The city is supplied with a vast quantity of water, by means of a very costly aqueduct, from the foot of Mount Vesuvius. Mr Addison says, it is incredible how great a multitude of retainers to the law there are in Naples, who find continual employment from the fiery temper of the inhabitants. There are five piazzas or squares in the city, appropriated to the nobility, viz. those called *Capuana*, *Nido*, *Montagna*, *Porto*, and *Porta Nova*. Of all the palaces, that of the king is not only the most magnificent, but also in the best style of architecture. The cathedral, though Gothic, is a very grand splendid edifice. It is here that the head and blood of St Januarius, the tutelary saint of Naples, are kept, the latter in two glass or crystal vials. The pretended liquefaction of the dried blood, as soon as brought near the head of the saint, is a thing well known; Mr Addison says, it is one of the most bungling tricks he ever saw. The harbour is spacious, and kept in good repair. It is fortified with a mole, which runs about a quarter of a mile into the sea, and at the extremity has a high lanthorn to direct ships safely into the harbour. Luxury here is restrained by severe sumptuary laws, and the women are more closely confined than in any other city of Italy. Here is an university and two academies of wits, the one called *Gli Ardenti*, and the other *Gli Otiosi*. The nunnery for ladies of quality is said to be the largest in the whole world, containing no less than 350 nuns, besides servants. The Mount of Piety, or the office for advancing money to the poor, on pledges, at a low interest, or without any, has an income of upwards of 50,000 ducats. The arsenal is said to contain arms for 50,000 men. The walls of the city consist of hard black quarry stones, called *piperno*. Instead of ice, vast quantities of snow are used for cooling their liquors, not so much as water being drank without it; so that, it is said, a scarcity of it would as soon occasion a mutiny as a dearth of corn or provisions. Certain persons, who farm the monopoly of it from the government, supply the city all the year round from a mountain about 18 miles off, at so much the pound. In the beginning of 1799, it was taken by a body of French troops under General Championet. The streets of this city were lighted for the first time on the 16th December, 1806. Naples stands 110 miles south-east from Rome, 164 north-east from Palermo in Sicily, 217 south-east from Florence, and 300 from Venice. E. Long. 14. 20. N. Lat. 40. 55.

Naples-
||
Narbonne

NARBO, in *Ancient Geography*, a town of the Volscæ Tectosages, called also *Narbo Martius*, from the Legio Martia, the colony led thither 59 years before the consulate of Cæsar, (Velleius); increased with a colony of the Decumani or tenth legion by Cæsar. An ancient trading town on the Atax, which discharges itself into the sea through the Lacus Rubresus, or Rubrensis. Capital of Gallia Narbonensis; surnamed *Colonia Julia Paterna*, from Julius Cæsar, the father of Augustus by adoption. Now called *Narbonne*, a city of Languedoc.

NARBONNE, is a city of France, in the department of Aude, with an archbishop's see, and is particularly famous for its honey. It is seated on a canal cut from the river Aude, which being but three miles from the sea, vessels come up it laden with merchandise, which renders

Narbonne || Nardus.

renders it a place of some trade. But though it pretends to the most remote antiquity under the Celtic kings, in ages anterior even to the Roman conquests, which under these latter masters gave its name to all *Gallia Narbonensis*, and was a colony of the first consideration, it is now dwindled to a wretched solitary town containing 9000 inhabitants, of whom three-fourths are priests and women. The streets and buildings are mean and ruinous; it has indeed a communication with the Mediterranean, from which Narbonne is only about three leagues distant, by means of a small river which intersects the place; but their commerce is very limited, and chiefly consists in grain which they export to Cette and Marseilles. No marks of Roman magnificence remain, except several inscriptions in different parts of the city. It is divided into the city and the town, which are joined together by a bridge, with houses on each side, in which the richest merchants live. There are several churches and convents; the metropolitan church has a handsome steeple. E. Long. 3. 6. N. Lat. 43. 11.

NARCISSUS, in fabulous history, the son of the river Cephissus and Liriope the daughter of Oceanus, was a youth of great beauty. Tiresias foretold that he should live till he saw himself. He despised all the nymphs of the country; and made Echo languish till she became a mere sound, by refusing to return her passion: but one day coming weary and fatigued from the chase, he stopped on the bank of a fountain to quench his thirst: when, seeing his own form in the water, he became so in love with the shadowy image, that he languished till he died. On which the gods, being moved at his death, changed him into the flower which bears his name.

NARCISSUS, a genus of plants belonging to the hexandria class; and in the natural method ranking under the 9th order, *Spathaceæ*. See BOTANY *Index*.

NARCOTICS, in *Medicine*, soporiferous drugs, which bring on a stupefaction. Among narcotics the most eminent are those usually prepared for medicinal uses from the poppy, especially opium; as also all those prepared from mandragoras, hyoscyamus, stramonium and datura. See MATERIA MEDICA *Index*.

NARDO, a pretty populous town in the kingdom of Naples, and in the Terra d'Otranto, with the title of a duchy and a bishop's see. E. Long. 18. 27. N. Lat. 43. 28.

In this little city are 8000 inhabitants. The steeple of its cathedral is built in a very uncommon but showy style of Gothic architecture. Luco Giordano and Solimeni have adorned the church with some agreeable paintings. This place was a part of the Balzo estate. The Aquavivas were the next possessors: they are thought to have come from the Marca di Ancona. In 1401, in consideration of their relationship to Pope Boniface IX. Laudislaus erected their manor of Atri into a dukedom, an honour till then seldom granted to any but princes of the blood royal. Claudius Aquaviva, a famous general of the Jesuits, who died in 1615, was of this family.

NARDUS, a genus of plants belonging to the triandria class; and in the natural method ranking under the 4th order, *Gramina*. See BOTANY *Index*.

This plant was highly valued by the ancients, both as an article of luxury and medicine. The *unguentum nardinum*, was used at baths and feasts as a favourite perfume. Its value is evident from that passage of Scripture, where our Saviour's head was anointed with a box of it, with which Judas found fault. From a passage in Horace, it appears that this ointment was so valuable among the Romans, that as much as could be contained in a small box of precious stone was considered as a sort of equivalent for a large vessel of wine, and a proper quota for a guest to contribute at an entertainment, according to the ancient custom:

Nardus, Narea.

——Nardo vina merebere,
Nardi parvus onyx eliciet cadum.

NAREA, the most southerly province of the empire of Abyssinia; a kingdom still governed by its own princes, who have the title of *Beneros*. Its territory was formerly more extensive than at present, the Galla having almost quite surrounded it, especially on the south-east and north. The country to the west is the most unknown part of Africa; the kingdom itself stands like a fortified place in the middle of a plain, being a high and mountainous country. A great many rivers, rising in the fourth and fifth degrees of north latitude, spread themselves over the level part of the country, and fill it with marshes all the way from south by east to north or north-west.—These marshes are bounded by mountains, of which those nearest the marshes are overgrown with coffee trees, the largest, if not the only ones, which grow in this country. The kingdom of Narea Proper is interspersed with small, unwholesome, but very fertile valleys. The mountainous country of Caffa adjoins immediately to Narca, and is said to be governed by a separate prince; but the Galla having settled themselves in all the flat ground to the very edge of the marshes, have in a great measure cut off the communication with Abyssinia for a long time past. The Nareans who inhabit the mountainous country have the lightest complexion of any people in Abyssinia; but those who inhabit the borders of the marshes are perfectly black, and have the features and woolly heads of negroes; but the mountaineers of Narca, and much more those of Caffa, are fair complexioned, more so than even the Neapolitans or Sicilians. It is said that snow has been seen to lie on some of the mountains of Caffa; but Mr Bruce imagines this to be a mistake, and thinks that it must have been hail.

Narea abounds with cattle, grain, and all kinds of provisions, both in the high and low country. The medium of commerce is gold, which they sell by weight; but the principal articles of trade are coarse cotton cloths, antimony, beads, and incense, which are carried from this country to the kingdom of Angola, and the parts of the African continent towards the Atlantic. The people are exceedingly brave; and though they have been driven out of the low country by multitudes of Galla, they now bid them defiance, and drive them from their frontiers whenever they come too near. The Narean prisoners taken in these skirmishes are sold to the Mahometan merchants at Gondar; and at Constantinople, Cairo, or in India, the women are more esteemed than those of any other part of the world. Both sexes have a cheerful kind disposition, and attach themselves inviolably to their masters, if properly treated. The people of Narea and Caffa speak a language peculiar to themselves.

NARRATION,

Narration. NARRATION, in oratory, poetry, and history, a recital or rehearsal of a fact as it happened, or as it is supposed to have happened. See ORATORY, N° 26. 123.

Concerning NARRATION *and Description* we have the following rules and observations in the Elements of Criticism.

1. The first rule is, That in history the reflections ought to be chaste and solid; for while the mind is intent upon truth, it is little disposed to the operation of the imagination. Strada's Belgic history is full of poetical images, which being discordant with the subject, are unpleasant; and they have a still worse effect by giving an air of fiction to a genuine history. Such flowers ought to be scattered with a sparing hand, even in epic poetry; and at no rate are they proper till the reader be warmed, and by an enlivened imagination be prepared to relish them: in that state of mind, they are agreeable; but while we are sedate and attentive to an historical chain of facts, we reject with disdain every fiction.

2. Vida, following Horace, recommends a modest commencement of an epic poem; giving for a reason that the writer ought to husband his fire. Besides bold thoughts and figures are never relished till the mind be heated and thoroughly engaged, which is not the reader's case at the commencement. Homer introduces not a single simile in the first book of the Iliad, nor in the first book of the Odyssey. On the other hand, Shakespeare begins one of his plays with a sentiment too bold for the most heated imagination:

Bedford. Hung be the heav'ns with black, yield day to night!
Comets, importing change of times and states,
Brandish your crystal tresses in the sky,
And with them scourge the bad revolting stars,
That have consented unto Henry's death!
Henry the Fifth, too famous to live long!
England ne'er lost a king of so much worth.
First part Henry VI.

The passage with which Strada begins his history, is too poetical for a subject of that kind; and at any rate too high for the beginning of a grave performance.

3. A third rule or observation is, That where the subject is intended for entertainment solely, not for instruction, a thing ought to be described as it appears, not as it is in reality. In running, for example, the impulse upon the ground is proportioned in some degree to the celerity of motion; though in appearance it is otherwise, for a person in swift motion seems to skim the ground, and scarcely to touch it. Virgil, with great taste, describes quick running according to appearance; and raises an image far more lively than by adhering scrupulously to truth:

Hos super advenit Volsca de gente Camilla,
Agmen agens equitum, et florentes ære catervas,
Bellatrix: non illa colo calathisve Minervæ
Fœmineas assueta manus; sed prælia virgo
Dura pati cursuque pedum prævertere ventos.
Illa vel intactæ segetis per summa volaret
Gramina, nec teneras cursu læsisset aristas:
Vel mare per medium, fluctu suspensa tumenti,
Ferret iter, celeres nec tingeret æquore plantas.
Æneid, vii. 803.

4. In narration as well as in description, objects ought to be painted so accurately as to form in the mind of the reader distinct and lively images. Every useless circumstance ought indeed to be suppressed, because every such circumstance loads the narration; but if a circumstance be necessary, however slight, it cannot be described too minutely. The force of language consists in raising complete images, which have the effect to transport the reader as by magic into the very place of the important action, and to convert him as it were into a spectator, beholding every thing that passes. The narrative in an epic poem ought to rival a picture in the liveliness and accuracy of its representations: no circumstance must be omitted that tends to make a complete image; because an imperfect image as well as any other imperfect conception, is cold and uninteresting. We shall illustrate this rule by several examples, giving the first place to a beautiful passage from Virgil:

Qualis *populcâ* mœrens Philomela sub umbrâ
Amissos queritur fœtus, quos durus *arator*
Observans nido *implumes* detraxit.
Georg. lib. iv. 511.

The poplar, ploughman, and unfledged young, though not essential in the description, tend to make a complete image, and upon that account are an embellishment.

Again:

Hic viridem Æneas *frondenti ex ilice* metam
Constituit, signum nautis. *Æneid*, v. 129.

Horace addressing to Fortune:

Te pauper ambit sollicita prece
Ruris colonus: te dominam æquoris,
Quicumque Bithynâ lacessit
Carpathium pelagus carinâ.
Carm. lib. i. ode 35.

—— Illum ex mœnibus hosticis
Matrona bellantis tyranni
Prospiciens, et adulta virgo,
Suspiret: Eheu, ne rudis agminum
Sponsus lacessat regius asperum
Tactu leonem, quem cruenta
Per medias rapit ira cædes.
Carm. lib. iii. ode 2.

Shakespeare says, "You may as well go about to turn the sun to ice by fanning in his face with a *peacock's* feather." The peacock's feather, not to mention the beauty of the object, completes the image: an accurate image cannot be formed of that fanciful operation, without conceiving a particular feather; and one is at a loss when this is neglected in the description. Again, "The rogues slighted me into the river with as little remorse, as they would have drown'd a bitch's blind puppies, fifteen i' th' litter."

Old Lady. You would not be a queen?
Anne. No, not for all the riches under heaven.
Old Lady. 'Tis strange: a threepence bow'd would hire me, old as I am, to queen it.
Henry VIII. act ii. sc. 5.

In the following passage, the action, with all its material

Narration. al circumstances, is represented so much to the life, that it would scarce appear more distinct to a real spectator; and it is the manner of description that contributes greatly to the sublimity of the passage—

He spake; and, to confirm his words, out flew
Millions of flaming swords, drawn from the thighs
Of mighty cherubim; the sudden blaze
Far round illumin'd hell: highly they rag'd
Against the Highest, and fierce with grasped arms,
Clash'd on their sounding shields the din of war,
Hurling defiance toward the vault of heav'n.
MILTON, book i.

The following passage from Shakespeare falls not much short of that now mentioned in particularity of description:

O you hard hearts! ye cruel men of Rome!
Knew you not Pompey? Many a time and oft
Have you climb'd up to walls and battlements,
To towers and windows, yea, to chimney tops,
Your infants in your arms, and there have sat
The live-long day with patient expectation
To see great Pompey pass the streets of Rome;
And when you saw his chariot but appear,
Have you not made an universal shout,
That Tyber trembled underneath his banks,
To hear the replication of your sounds,
Made in his concave shore?
Julius Cæsar, act i. sc. 1.

The following passage is scarcely inferior to either of those mentioned:

"Far before the rest, the son of Ossian comes: bright in the smiles of youth, fair as the first beams of the sun. His long hair waves on his back: his dark brow is half beneath his helmet. The sword hangs loose on the hero's side; and his spear glitters as he moves. I fled from his terrible eye, king of high Temora. *Fingal.*

The Henriade of Voltaire errs greatly against the foregoing rule: every incident is touched in a summary way, without ever descending to circumstances. This manner is good in a general history, the purpose of which is to record important transactions: but in a fable it is cold and uninteresting; because it is impracticable to form distinct images of persons or things represented in a manner so superficial.

It is observed above, that every useless circumstance ought to be suppressed. The crowding such circumstances is, on the one hand, not less to be avoided than the conciseness for which Voltaire is blamed, on the other. In the Æneid, Barce, the nurse of Sichæus, whom we never hear of before nor after, is introduced for a purpose not more important than to call Anna to her sister Dido: and that it might not be thought unjust in Dido, even in this trivial circumstance, to prefer her husband's nurse before her own, the poet takes care to inform his reader, that Dido's nurse was dead. To this may be opposed a beautiful passage in the same book, where, after Dido's last speech, the poet, without detaining his readers by describing the manner of her death, hastens to the lamentation of her attendants:

Dixerat: atque illam media inter talia ferro Narration.
Collapsam aspiciunt comites, ensemque cruore
Spumantem, sparsasque manus. It clamor ad alta
Atria; concussam bacchatur fama per urbem;
Lamentis gemituque, et fœmineo ululatu
Tecta fremunt, resonat magnis plangoribus æther.
Lib. iv. 663.

As an appendix to the foregoing rule, may be added the following observation, That to make a sudden and strong impression, some single circumstance, happily selected, has more power than the most laboured description. Macbeth, mentioning to his lady some voices he heard while he was murdering the King, says,

There's one did laugh in's sleep, and one cry'd
Murder!
They wak'd each other; and I stood and heard
them:
But they did say their prayers, and address them
Again to sleep.
Lady. There are two lodg'd together.
Macbeth. One cry'd, God bless us! and, Amen!
the other;
As they had seen me with these hangman's hands,
Listening their fear. I could not say Amen,
When they did say, God bless us.
Lady. Consider it not so deeply.
Macbeth. But wherefore could not I pronounce
Amen!
I had most need of blessing, and Amen
Stuck in my throat.
Lady. These deeds must not be thought
After these ways; so, it will make us mad.
Macbeth. Methought, I heard a voice cry, Sleep
no more!
Macbeth doth murder sleep, &c. Act ii. sc. 2.

Describing Prince Henry:

I saw young Harry, with his beaver on,
His cuisses on his thighs, gallantly arm'd,
Rise from the ground like feather'd Mercury;
And vaulted with such ease into his seat,
As if an angel dropt down from the clouds,
To turn and wind a fiery Pegasus,
And witch the world with noble horsemanship.
First Part Henry IV. act iii. sc. 3.

King Henry. Lord Cardinal, if thou think'st on
Heaven's bliss,
Hold up thy hand, make signal of thy hope.
He dies, and makes no sign!
Second Part Henry VI. act. iii. sc. iii.

The same author, speaking ludicrously of an army debilitated with diseases, says,

"Half of them dare not shake the snow from off their cassocks, lest they shake themselves to pieces."

"I have seen the walls of Balclutha, but they were desolate. The flames had resounded in the halls: and the voice of the people is heard no more. The stream of Clutha was removed from its place by the fall of the walls. The thistle shook there its lonely head: the moss whistled to the wind. The fox looked out from the windows: and the rank grass of the wall waved round

Narration. round his head. Desolate is the dwelling of Morna: silence is in the house of her fathers." *Fingal.*

To draw a character is the master stroke of description. In this Tacitus excels; his portraits are natural and lively, not a feature wanting or misplaced. Shakespeare, however, exceeds Tacitus in liveliness; some characteristical circumstance being generally invented or laid hold of, which paints more to the life than many words. The following instances will explain our meaning, and at the same time prove our observation to be just.

Why should a man, whose blood is warm within,
Sit like his grandsire cut in alabaster?
Sleep when he wakes, and creep into the jaundice,
By being peevish? I tell thee what, Anthonio,
(I love thee, and it is my love that speaks),
There are a sort of men, whose visages
Do cream and mantle like a standing pond;
And do a wilful stillness entertain,
With purpose to be dress'd in an opinion
Of wisdom, gravity, profound conceit;
As who should say, I am Sir Oracle,
And when I ope my lips, let no dog bark!
O my Anthonio! I do know of those,
That therefore only are reputed wise,
For saying nothing.
Merchant of Venice, act i. sc. 1.

Again:

"Gratiano speaks an infinite deal of nothing, more than any man in all Venice: his reasons are two grains of wheat hid in two bushels of chaff; you shall seek all day ere you find them; and when you have them, they are not worth the search." *Ibid.*

In the following passage a character is completed by a single stroke:

Shallow. O the mad days that I have spent; and to see how many of mine old acquaintance are dead.

Silence. We shall all follow, cousin.

Shallow. Certain, 'tis certain, very sure, very sure; Death (as the Psalmist saith) is certain to all: all shall die. How a good yoke of bullocks at Stamford fair?

Slender. Truly cousin, I was not there.

Shallow. Death is certain. Is old *Double* of your town living yet?

Silence. Dead, Sir.

Shallow. Dead! see, see: he drew a good bow: and dead. He shot a fine shot. How a score of ewes now?

Silence. Thereafter as they be. A score of good ewes may be worth ten pounds.

Shallow. And is old *Double* dead?
Second part Henry IV. act iii. sc. 2.

Describing a jealous husband:

"Neither press, coffer, chest, trunk, well, vault, but he hath an abstract for the remembrance of such places, and goes to them by his note. There is no hiding you in the house." *Merry Wives of Windsor*, act iv. sc. 3.

Congreve has an inimitable stroke of this kind in his comedy of *Love for Love:*

Ben Legend. Well, father, and how do all at home? how does brother Dick, and brother Val?

Sir Sampson. Dick, body o' me, Dick has been dead these two years. I writ you word when you were at Leghorn. Narration.

Ben. Mess, that's true; marry I had forgot. Dick's dead, as you say. Act iii. sc. 6.

Falstaff speaking of Ancient Pistol:

"He's no swaggerer, hostess; a tame cheater i'faith: you may stroak him as gently as a puppy greyhound; he will not swagger with a Barbary hen, if her feathers turn back in any show of resistance."
Second part Henry IV. act ii. sc. 4.

Ossian, among his other excellencies, is eminently successful in drawing characters; and he never fails to delight his reader with the beautiful attitudes of his heroes. Take the following instances:

"O Oscar! bend the strong in arm; but spare the feeble hand. Be thou a stream of many tides against the foes of thy people; but like the gale that moves the grass to those who ask thine aid.—So Trenmor lived; such Trathal was; and such has Fingal been. My arm was the support of the injured; and the weak rested behind the lightning of my steel."

"We heard the voice of joy on the coast, and we thought that the mighty Cathmor came. Cathmor the friend of strangers! the brother of red-haired Cairbar! But their souls were not the same; for the light of heaven was on the bosom of Cathmor. His towers rose on the banks of Atha: seven paths led to his halls: seven chiefs stood on these paths, and called the stranger to the feast. But Cathmor dwelt in the wood to avoid the voice of praise."

"Dermid and Oscar were one: they reaped the battle together. Their friendship was strong as their steel; and death walked between them to the field. They rush on the foe like two rocks falling from the brow of Ardven. Their swords are stained with the blood of the valiant: warriors faint at their name. Who is equal to Oscar but Dermid? who to Dermid but Oscar?

"Son of Comhal, replied the chief, the strength of Morni's arm has failed: I attempted to draw the sword of my youth, but it remains in its place: I throw the spear, but it falls short of the mark: and I feel the weight of my shield. We decay like the grass of the mountain, and our strength returns no more. I have a son, O Fingal! his soul has delighted in the actions of Morni's youth; but his sword has not been fitted against the foe, neither has his fame begun. I come with him to battle, to direct his arm. His renown will be a sun to my soul, in the dark hour of my departure. O that the name of *Morni* were forgot among the people! that the heroes would only say, *Behold the father of Gaul.*"

Some writers, through heat of imagination, fall into contradiction; some are guilty of downright absurdities; and some even rave like madmen. Against such capital errors one cannot be more effectually warned than by collecting instances; and the first shall be of a contradiction, the most venial of all. Virgil speaking of Neptune,

Narration. Interea magno misceri murmure pontum,
Emissamque hyemem sensit Neptunus, et imis
Stagna refusa vadis; *graviter commotus*, et alto
Prospiciens, summâ *placidum* caput extulit undâ.
Æneid, i. 128.

Again:

When first young Maro, in his boundless mind,
A work t'outlast *immortal* Rome design'd.
Essay on Criticism, 30.

The following examples are of absurdities.

"Alii pulsis é tormento catenis discerpti sectique, dimidiato corpore pugnabant sibi superstites, ac peremptæ partis ultores." STRADA, *Dec.* ii. 2.

Il pover huomo, che non sen' era accorto,
Andava combattendo, ed era morto. *Berni.*

He fled, but flying, left his life behind.
Iliad, xi. 443.

Full through his neck the weighty falchion sped:
Along the pavement roll'd the mutt'ring head.
Odyssey, xxii. 365.

The last article is of raving like one mad. Cleopatra speaking to the aspic,

——————Welcome, thou kind deceiver,
Thou best of thieves; who, with an easy key,
Dost open life, and unperceiv'd by us
Ev'n steal us from ourselves; discharging so
Death's dreadful office, better than himself;
Touching our limbs so gently into slumber,
That Death stands by, deceiv'd by his own image,
And thinks himself but sleep.
DRYDEN, *All for Love*, act v.

Having discussed what observations occurred upon the thoughts or things expressed, we proceed to what more peculiarly concerns the language or verbal dress. As words are intimately connected with the ideas they represent, the emotions raised by the sound and by the sense ought to be concordant. An elevated subject requires an elevated style; what is familiar, ought to be familiarly expressed: a subject that is serious and important, ought to be clothed in plain nervous language: a description, on the other hand, addressed to the imagination, is susceptible of the highest ornaments that sounding words and figurative expression can bestow upon it.

We shall give a few examples of the foregoing rules. A poet of any genius is not apt to dress a high subject in low words; and yet blemishes of that kind are found even in classical works. Horace, observing that men are satisfied with themselves, but seldom with their condition, introduces Jupiter indulging to each his own choice:

Jam faciam quod vultis; eris tu, qui modo miles,
Mercator; tu, consultus modo, rustieus: hinc vos,
Vos hinc, mutatis discedite partibus. eia,
Quid? statis? nolint. atqui licet esse beatis.
Quid causæ est, merito quin illis *Jupiter ambas*
Iratus buccas inflet, neque se fore posthac
Tam facilem dicat, votis ut præbeat aurem?
Sat. i. 16.

Jupiter in wrath puffing up both cheeks, is a low and even ludicrous expression, far from suitable to the gravity and importance of the subject: every one must feel the discordance. The following couplet, sinking far below the subject, is no less ludicrous: Narration.

Not one looks backward, onward still he goes,
Yet ne'er looks forward farther than his nose.
Essay on Man, ep. iv. 223.

On the other hand, to raise the expression above the tone of the subject, is a fault than which none is more common. Take the following instances:

Orean le plus fidéle à servir ses desseins,
Ne sous le ciel brûlant des plus noirs Africains.
Bajazet, act iii. sc. 8.

Les ómbres par trois fois ont obscurci les cieux
Depuis que le sommeil n'est entré dans vos yeux;
Et le jour a trois fois chassé la nuit obscure
Depuis que votre corps languit sans nourriture.
Phædra, act i. sc. 3.

Assuerus. Ce mortel, qui montra tant de zéle pour moi, Vit-il encore?
Asaph. ——Il voit l'astre qui vous éclaire.
Esther, act ii. sc. 3.

Oui, c'est Agamemnon, c'est ton roi qui t'eveille;
Viens, reconnois la voix qui frappe ton oreille.
Iphigenie.

No jocund health that Denmark drinks to-day,
But the great cannon to the clouds shall tell;
And the king's rowse the heav'n shall bruit again,
Respeaking earthly thunder.
Hamlet, act i. sc. 2.

——————In the inner room
I spy a winking lamp, that weakly strikes
The ambient air, scarce kindling into light.
SOUTHERNE, *Fate of Capua*, act iii.

In the Funeral Orations of the bishop of Meaux, the following passages are raised far above the tone of the subject;

"L'Ocean etonné de se voir traversé tant de fois, en des appareils si divers, et pour des causes si differentes, &c." Pag. 6.

"Grande reine, je satisfais à vos plus tendres desirs, quand je célébre ce monarque; et son cœur qui n'a jamais vêcu que pour lui, s'eveille, tout poudre qu'il est, et devient sensible, même sous ce drap mortuaire, au nom d'un epoux si cher." Pag. 32.

The following passage, intended, one would imagine, as a receipt to boil water, is altogether burlesque by the laboured elevation of the diction:

A massy cauldron of stupendous frame
They brought, and plac'd it o'er the rising flame:
Then heap the lighted wood; the flame divides
Beneath the vase, and climbs around the sides:
In its wide womb they pour the rushing stream:
The boiling water bubbles to the brim.
Iliad, xviii. 405.

In a passage at the beginning of the 4th book of Telemachus, one feels a sudden bound upward without preparation, which accords not with the subject:

"Calypso,

Narration. "Calypso, qui avoit éte jusq' à ce moment immobile et transporteé de plaisir en éeoutant les aventures de Télémaque, l'interrompit pour lui faire prendre quelque repôs. Il est tems, lui dit-elle, que vous alliez goûter la douceur du sommeil aprés tant de travaux. Vous n'avez rien à craindre ici; tout vous est favorable. Abandonnez vous donc à la joie. Goutez la paix, et tous les autres dons des dieux dont vous allez être comblé. Demain, *quand l'Aurore avec ses doigts de rôses entr'ouvrira les portes dorées de l'Orient, et que les chevaux du soleil, sortant de l'onde amére, répandront les flames du jour, pour chasser devant eux toutes les etoiles du ciel*, nous reprendrons, mon cher Télémaque, l'histoire de vos malheurs."

This obviously is copied from a similar passage in the Æneid, which ought not to have been copied, because it lies open to the same censure; but the force of authority is great:

At regina gravi jamdudum saucia cura,
Vulnus alit venis, et cœco carpitur igni.
Multa viri virtus animo, multusque recursat
Gentis honos: hærent infixi pectore vultus,
Verbaque: nec placidam membris dat cura quietem.
Postera Phœbea lustrabat lampade terras,
Humentemque Aurora polo dimoverat umbram;
Cum sic unanimem alloquitur malesana sororem.
Lib. iv. 1.

The language of Homer is suited to his subject, not less accurately than the actions and sentiments of his heroes are to their characters. Virgil, in that particular, falls short of perfection: his language is stately throughout; and though he deseends at times to the simplest branches of cookery, roasting and boiling for example, yet he never relaxes a moment from the high tone.—In adjusting his language to his subject, no writer equals Swift. We can recollect but one exception, which at the same time is far from being gross: The Journal of a modern Lady is composed in a style blending sprightliness with familiarity, perfectly suited to the subject; in one passage, however, the poet, deviating from that style, takes a tone above his subject. The passage we have in view begins l. 115. But *let me now a while survey*, &c. and ends at l. 135.

It is proper to be observed upon this head, that writers of inferior rank are continually upon the stretch to enliven and enforce their subject by exaggeration and superlatives. This unluckily has an effect contrary to what is intended; the reader, disgusted with language that swells above the subject, is led by contrast to think more meanly of the subject than it may possibly deserve. A man of prudence, beside, will be no less careful to husband his strength in writing than in walking; a writer, too liberal of superlatives, exhausts his whole stock upon ordinary incidents, and reserves no share to express, with greater energy, matters of importance.

Many writers of that kind abound so in epithets, as if poetry consisted entirely in high sounding words. Take the following instance:

When black brow'd night her dusky mantle spread,
And wrapt in solemn gloom the sable sky;
When soothing sleep her opiate dews had shed,
And seal'd in silken slumbers every eye:
My waking thought admits no balmy rest, Narration.
Nor the sweet bliss of soft oblivion share;
But watchful woe distracts my aching breast,
My heart the subject of corroding care:
From haunts of men with wandering steps and slow
I solitary steal, and soothe my pensive woe.

Here every substantive is faithfully attended by some tumid epithet.

We proceed to a second remark, not less important than the former. No person of reflection but must be sensible, that an incident makes a stronger impression on an eye witness, than when heard at second hand. Writers of genius, sensible that the eye is the best avenue to the heart, represent every thing as passing in our sight; and, from readers or hearers, transform us as it were into spectators: a skilful writer conceals himself, and presents his personages: in a word, every thing becomes dramatic as much as possible. Plutarch, *de gloria Atheniensium*, observes, that Thucydides makes his reader a spectator, and inspires him with the same passions as if he were an eye witness.

In the fine arts, it is a rule to put the capital objects in the strongest point of view; and even to present them oftener than once, where it can be done. In history painting, the principal figure is placed in the front, and in the best light: an equestrian statue is placed in a centre of streets, that it may be seen from many places at once. In no composition is there greater opportunity for this rule than in writing:

——— Sequitur pulcherrimus Astur,
Astur equo fidens et versicoloribus armis.
Æneid, x. 180.

——— Full many a lady
I've ey'd with best regard, and many a time
Th' harmony of their tongues hath into bondage
Brought my too diligent ear: for several virtues
Have I lik'd several women: never any
With so full soul, but some defect in her
Did quarrel with the noblest grace she ow'd,
And put it to the foil. But you, O you,
So perfect, and so peerless, are created
Of every creature's best. *Tempest*, act iii. sc. 1.

Orlando.———Whate'er you are
That, in the desert inaccessible,
Under the shade of melancholy boughs,
Lose and neglect the creeping hours of time;
If ever you have look'd on better days;
If ever been where bells have knoll'd to church;
If ever sat at any good man's feast;
If ever from your eyelids wip'd a tear,
And known what 'tis to pity, and be pity'd;
Let gentleness my strong enforcement be,
In the which hope I blush, and hide my sword.
Duke sen. True is it that we have seen better days,
And have with holy bell been knoll'd to church;
And sat at good men's feasts; and wip'd our eyes
Of drops that sacred pity had engender'd;
And therefore sit you down in gentleness,
And take upon command what help we have,
That to your wanting may be minist'red.
As you like it.

With thee conversing I forget all time;
All seasons and their change, all please alike.

Narration.

Sweet is the breath of morn, her rising sweet,
With charm of earliest birds; pleasant the sun
When first on this delightful land he spreads
His orient beams on herbs, tree, fruit, and flow'r
Glist'ring with dew; fragrant the fertile earth
After soft show'rs; and sweet the coming on
Of grateful ev'ning mild, the silent night
With this her solemn bird, and this fair moon,
And these the gems of heav'n, her starry train:
But neither breath of morn, when she ascends
With charm of earliest birds, nor rising sun
On this delightful land, nor herb, fruit, flow'r,
Glist'ring with dew, nor fragrance after show'rs,
Nor grateful ev'ning mild, nor silent night,
With this her solemn bird, nor walk by moon
Or glittering star light, without thee is sweet.
Paradise Lost, book iv. l. 634.

"What mean ye, that ye use this proverb, The fathers have eaten sour grapes, and the children's teeth are set on edge? As I live, saith the Lord God, ye shall not have occasion to use this proverb in Israel. If a man keep my judgments to deal truly, he is just, he shall surely live. But if he be a robber, a shedder of blood: if he have eaten upon the mountains, and defiled his neighbour's wife: if he have oppressed the poor and needy, have spoiled by violence, have not restored the pledge, have lift up his eyes to idols, have given forth upon usury, and have taken increase: shall he live? he shall not live: he shall surely die; and his blood shall be upon him. Now, lo, if he beget a son, that seeth all his father's sins, and considereth, and doth not such like; that hath not eaten upon the mountains, hath not lift up his eyes to idols, nor defiled his neighbour's wife, hath not oppressed any, nor withheld the pledge, neither hath spoiled by violence, but hath given his bread to the hungry, and covered the naked with a garment: that hath not received usury nor increase, that hath executed my judgments, and walked in my statutes: he shall not die for the iniquity of his father; he shall surely live. The soul that sinneth, it shall die; the son shall not bear the iniquity of the father, neither shall the father bear the iniquity of the son; the righteousness of the righteous shall be upon him, and the wickedness of the wicked shall be upon him. Have I any pleasure that the wicked should die, saith the Lord God; and not that he should return from his ways, and live!" *Ezekiel* xvii.

A concise comprehensive style is a great ornament in narration; and a superfluity of unnecessary words, not less than of circumstances, a great nuisance. A judicious selection of the striking circumstances, clothed in a nervous style, is delightful. In this style, Tacitus excels all writers, ancient and modern. Instances are numberless: take the following specimen:

"Crebra hinc prælia, et sæpius in modum latrocinii: per saltus, per paludes; ut cuique fors aut virtus: temere, proviso, ob iram, ob prædam, jussu, et aliquando ignaris ducibus." *Annal.* lib. xii. § 39.

After Tacitus, Ossian in that respect justly merits the place of distinction. One cannot go wrong for examples in any part of the book.

If a concise or nervous style be a beauty, tautology must be a blemish; and yet writers, fettered by verse, are not sufficiently careful to avoid this slovenly practice: they may be pitied, but they cannot be justified. Take for a specimen the following instances, from the best poet, for versification at least, that England has to boast of: Narration.

High on his helm celestial lightnings play,
His beamy shield emits a living ray;
Th' unweary'd blaze incessant streams supplies,
Like the red star that fires the autumnal skies.
Iliad. 5.

Strength and omnipotence invest thy throne.
Ibid. 576.

So silent fountains, from a rock's tall head,
In sable streams soft trickling waters shed.
Ibid. ix. 19.

His clanging armour rung. *Ibid.* xii. 94.

Fear on their cheek, and horror in their eye.
Ibid. xv. 4.

The blaze of armour flash'd against the day.
Ibid. xvii. 736.

As when the piercing blasts of Boreas blow.
Ibid. xix. 380.

And like the moon, the broad refulgent shield
Blaz'd with long rays, and gleam'd athwart the field.
Ibid. xix. 402.

No—could our swiftness o'er the winds prevail,
Or beat the pinions of the western gale,
All were in vain—— *Ibid.* xix. 604.

The humid sweat from every pore descends.
Ibid. xxiii. 829.

We close this article with a curious inquiry. An object, however ugly to the sight, is far from being so when represented by colours or by words. What is the cause of this difference? With respect to painting, the cause is obvious: a good picture, whatever the subject be, is agreeable by the pleasure we take in imitation; and this pleasure overbalancing the disagreeableness of the subject, makes the picture upon the whole agreeable. With respect to the description of an ugly object, the cause follows. To connect individuals in the social state, no particular contributes more than language, by the power it possesses of an expeditious communication of thought, and a lively representation of transactions. But nature hath not been satisfied to recommend language by its utility merely: independent of utility, it is made susceptible of many beauties, which are directly felt, without any intervening reflection. And this unfolds the mystery; for the pleasure of language is so great, as in a lively description to overbalance the disagreeableness of the image raised by it. This, however, is no encouragement to choose a disagreeable subject; for the pleasure is incomparably greater where the subject and the description are both of them agreeable.

The following description is upon the whole agreeable, though the subject described is in itself dismal:

Nine times the space that measures day and night
To mortal men, he with his horrid crew

Narration.

Lay vanquished, rolling in the fiery gulf,
Confounded though immortal! but his doom
Reserv'd him to more wrath; for now the thought
Both of lost happiness and lasting pain
Torments him: round he throws his baleful eyes
That witness'd huge affliction and dismay,
Mix'd with obdurate pride and stedfast hate.
At once as far as angels ken he views
The dismal situation waste and wild:
A dungeon horrible, on all sides round
As one great furnace flamed; yet from those flames
No light, but rather darkness visible
Serv'd only to discover sights of wo,
Regions of sorrow, doleful shades, where peace
And rest can never dwell, hope never comes
That comes to all; but torture without end
Still urges, and a fiery deluge, fed
With ever-burning sulphur unconsum'd!
Such place eternal justice had prepar'd
For those rebellious. *Paradise Lost*, book i. 50.

An unmanly depression of spirits in time of danger is not an agreeable sight; and yet a fine description or representation of it will be relished:

K. Richard. What must the king do now? must he submit?
The king shall do it: must he be depos'd?
The king shall be contented: must he lose
The name of king? o' God's name let it go:
I'll give my jewels for a set of beads;
My gorgeous palace, for a hermitage;
My gay apparel, for an almsman's gown;
My figur'd goblets, for a dish of wood;
My sceptre for a palmer's walking staff;
My subjects, for a pair of carved saints;
And my large kingdom, for a little grave;
A little, little, grave,——an obscure grave.
Or I'll be buried in the king's highway;
Some way of common tread, where subjects feet
May hourly trample on their sovereign's head;
For on my heart they tread now, whilst I live;
And, bury'd once, why not upon my head?
Richard II. act iii. sc. 6.

Objects that strike terror in a spectator, have in poetry and painting a fine effect. The picture, by raising a slight emotion of terror, agitates the mind; and in that condition every beauty makes a deep impression. May not contrast heighten the pleasure, by opposing our present security to the danger of encountering the object represented.

——————The other shape,
If shape it might be call'd that shape had none
Distinguishable in member, joint, or limb;
Or substance might be call'd that shadow seem'd,
For each seem'd either; black it stood as night,
Fierce as ten furies, terrible as hell,
And shook a dreadful dart. *Par. Lost*, book ii. 666.

——————Now storming fury rose,
And clamour such as heard in heaven till now
Was never: arms on armour clashing bray'd
Horrible discord, and the madding wheels
Of brazen chariots rage; dire was the noise
Of conflict; overhead the dismal hiss
Of fiery darts in flaming volleys flew,
And flying vaulted either host with fire.
So under fiery cope together rush'd
Both battles main, with ruinous assault
And unextinguishable rage: all heaven
Resounded, and had earth been then, all earth
Had to her centre shook. *Ibid.* book vi. 207.

Narration, Narses.

Ghost.——————But that I am forbid
To tell the secrets of my prison-house,
I could a tale unfold, whose lightest word
Would harrow up thy soul, freeze thy young blood,
Make thy two eyes, like stars start from their spheres,
Thy knotty and combined locks to part,
And each particular hair to stand on end,
Like quills upon the fretful porcupine:
But this eternal blazon must not be
To ears of flesh and blood. *Hamlet*, act i. sc. 8.

Gratiano. Poor Desdemona! I'm glad thy father's dead:
Thy match was mortal to him; and pure grief
Shore his old thread in twain. Did he live now,
This sight would make him do a desp'rate turn:
Yea, curse his better angel from his side,
And fall to reprobation. *Othello*, act v. sc. 8.

Objects of horror must be excepted from the foregoing theory; for no description, however lively, is sufficient to overbalance the disgust raised even by the idea of such objects. Every thing horrible ought therefore to be avoided in a description.

NARSES, the eunuch who rivalled Belisarius in heroism under the reign of the emperor Justinian, emerged from obscurity A. D. 538. From the domestic service of the palace, and the administration of the private revenue, he was suddenly exalted to the head of an army. He is ranked among the few eunuchs who have rescued that unhappy name from the contempt and hatred of mankind. A feeble diminutive body concealed the soul of a statesman and a warrior. His youth had been employed in the management of the loom and distaff, in the cares of the household, and the service of female luxury; but, while his hands were busy, he secretly exercised the faculties of a vigorous and discerning mind. A stranger to the schools and the camp, he studied in the palace to dissemble, to flatter, and to persuade; and as soon as he approached the person of the emperor, Justinian listened with surprise and pleasure to the manly counsels of his chamberlain and private treasurer. The talents of Narses were tried and improved in frequent embassies; he led an army into Italy, acquired a practical knowledge of the war and the country, and presumed to strive with the genius of Belisarius. Twelve years after his return, the eunuch was chosen to achieve the conquest which had been left imperfect by the first of the Roman generals. Instead of being dazzled by vanity or emulation, he seriously declared, that unless he were armed with an adequate force, he would never consent to risk his own glory and that of his sovereign. Justinian granted to the favourite what he might have denied to the hero: the Gothic war was rekindled from its ashes, and the preparations were not unworthy of the ancient majesty of the empire.

Narses defeated the Goths, the Franks, and the Alamanni:

Narsus || Nassau.

Alamanni; the Italian cities opened their gates to the conqueror; he entered the capital in triumph; and having established the seat of his government at Ravenna, continued 15 years to govern Italy under the title of *Exarch*.

His virtues, we are told, were stained with avarice; and in this provincial reign he accumulated a treasure of gold and silver which surpassed the modesty of a private fortune. His government was oppressive or unpopular; and the general discontent was expressed with freedom by the deputies of Rome. Before the throne of Justinian they boldly declared, that their Gothic servitude had been more tolerable than the despotism of a Greek eunuch; and that unless their tyrant were instantly removed, they would consult their own happiness in the choice of a master. Thus was his disgrace the effect of the people's disaffection; and his death, though in the extreme period of old age, was unseasonable and premature, since his genius alone could have repaired the last and fatal error of his life. He died about the year 567, and, as some say, at the advanced age of 95; but this does not appear very probable. See Gibbon's Rom. Hist. vol. iv. 4to edit. p. 194, 298, &c.

NARVA, a strong town of the Russian empire, in Livonia, with a castle and a harbour. It was taken by the Muscovites from the Danes in 1558, by the Swedes in 1581, and they defeated the Muscovites near it in 1700; but it was retaken by the Russians in 1704 by storm, and the inhabitants sent to Astracan. It is seated on the river Narva, 95 miles south-west of Wiburg, and 172 north-east of Riga. E. Long. 29. 0. N. Lat. 59. 8.

NARWAL, a genus of whales. See MONODON, CETOLOGY *Index*.

NASSAU-SIEGEN, a small principality of Germany in the Westerwalde, is in general a mountainous woody country, with some arable and pasture ground, and a good breed of cattle. Its manufactures are chiefly those of iron and steel, having an iron mine in the neighbourhood of Siegen. Count John the Younger, in 1626, embraced the Roman Catholic religion, and endeavoured to introduce it into the country; but the principality, upon the extinction of the line of Nassau-Siegen in 1743, falling to the line of Nassau-Dietz, and therein to the prince of Orange, hereditary stadtholder of the United Provinces, the Protestants were delivered from their apprehensions of Popish tyranny and bigotry. The prince, on account of these territories, has a seat and voice at the diets of the empire and circle in the college of princes. His assessment in the matricula for Nassau-Siegen is 77 florins monthly; and towards the maintenance of the chamber judicatory, 50 rixdollars, six kruitzers and a half, each term. The revenue of this principality is estimated at 100,000 rixdollars.

NASSAU Dillenbourg, a principality of Germany, situated near the former. It has not much arable land, but plenty of wood, good quarries of stone, some silver and vitriol, copper and lead, with store of iron, for the working and smelting of which there are many forges and founderies in the country; and by these, and the sale of their iron, the inhabitants chiefly subsist. Calvinism is the religion of the principality, which contains five towns and two boroughs, and belongs entirely to William V. prince of Orange, and hereditary stadtholder of the United Provinces, whose father succeeded to a part of it in 1739 on the death of Prince Christian, and to the rest in 1743 on the death of Prince William Hyacynth of Siegen. The prince, on account of this principality also and Dietz, has a seat and voice in the college of princes, at the diets of the empire and circle. His assessment in the matricula, for Nassau-Dillenbourg, is 102 florins monthly; and to the chamber judicatory, 59 rixdollars six and half kruitzers, each term. His revenue from this principality is computed at above 130,000 florins.

Nassau || National Debt.

NASSAU-Hadamar, a country of Germany, which, till the year 1711, had princes of its own; but now belongs wholly to William V. prince of Orange.

NASSAU, prince of Orange. See MAURICE.

NATES, in *Anatomy*, a term expressing those two fleshy exterior parts of the body, vulgarly called the *buttocks*. See ANATOMY.

NATES Cerebri, are two circular protuberances of the brain, situated on the back side of the medulla oblongata, near the cerebellum.

NATION, a collective term, used for a considerable number of people inhabiting a certain extent of land, confined within fixed limits, and under the same government.

NATIONAL DEBT: the money owing by government.

Our limits permit us to give but a very general sketch of this subject: However, as it is of considerable importance to every inhabitant of these kingdoms, we shall endeavour to give as clear and comprehensive a view of it as the bounds necessarily prescribed us will admit. In order to this, it may not be improper to refer back to the times that have gone before us, that we may the better discover the nature of public revenues, the manner of their expenditure, and the causes of public debt.

In that rude state of society which precedes the extension of commerce and the improvements of manufactures, when those expensive luxuries which commerce and manufactures can alone introduce, are altogether unknown; the person who possesses a large revenue can spend or enjoy that revenue in no other way than by maintaining nearly as many people as it can maintain. Among our feudal ancestors, the long time during which estates used to continue in the same family, sufficiently demonstrates the general disposition of people to live within their income. Though the rustic hospitality constantly exercised by the great landholders may not to us in the present times seem consistent with that order which we are apt to consider as inseparably connected with good economy, yet we must certainly allow them to have been at least so far frugal as not commonly to have spent their whole income. Some part of this money, perhaps, they spent in purchasing the few objects of vanity and luxury with which the circumstances of the times could furnish them: but some part of it they seem commonly to have hoarded. They could not well indeed do any thing else but hoard whatever money they saved. To trade was disgraceful to a gentleman; and to lend money at interest, which at that time was considered as usury and prohibited by law, would have been still more so.

Smith's Wealth of Nations.

The

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The same disposition to save and to hoard prevailed in the sovereign as well as in the subjects. Among nations to whom commerce and manufactures are little known, the sovereign is in a situation which naturally disposes him to the parsimony requisite for accumulation. In that situation the expence even of a sovereign cannot be directed by that vanity which delights in the gaudy finery of a court. The ignorance of the times affords but few of the trinkets in which that finery consists. Standing armies are not then necessary; so that the expence even of a sovereign, like that of any other great lord, can be employed in scarce any thing but bounty to his tenants and hospitality to his retainers. But bounty and hospitality very seldom lead to extravagance: though vanity almost always does. All the ancient sovereigns of Europe accordingly had treasures. Every Tartar chief in the present times is said to have one.

In a commercial country abounding with every sort of expensive luxury, the sovereign, in the same manner as almost all the great proprietors in his dominions, naturally spends a great part of his revenue in purchasing those luxuries. His own and the neighbouring countries supply him abundantly with all the costly trinkets which compose the splendid but insignificant pageantry of a court. His ordinary expence becomes equal to his ordinary revenue, and it is well if it does not frequently exceed it. The amassing of treasure can no longer be expected: and when extraordinary exigencies require extraordinary expences, he must necessarily call upon his subjects for an extraordinary aid. The late king of Prussia and his father are the only great princes of Europe who, since the death of Henry IV. of France in 1610, are supposed to have amassed any considerable treasure. The parsimony which leads to accumulation has become almost as rare in republican as in monarchical governments. The Italian republics, the United Provinces of the Netherlands, are all in debt. The canton of Berne is the single republic in Europe which has amassed any considerable treasure. The other Swiss republics have not. The taste for some sort of pageantry, for splendid buildings at least and other public ornaments, frequently prevails as much in the apparently sober senate house of a little republic as in the dissipated court of the greatest king.

The want of parsimony in time of peace imposes the necessity of contracting debt in time of war. When war comes, there is no money in the treasury but what is necessary for carrying on the ordinary expence of the peace establishment. In war an establishment of three or four times that expence becomes necessary for the defence of the state, and consequently a revenue three or four times greater than the peace revenue. Supposing that the sovereign should have what he scarce ever has, the immediate means of augmenting his revenue in proportion to the augmentation of his expence; yet still the produce of the taxes, from which this increase of revenue must be drawn, will not begin to come into the treasury till perhaps ten or twelve months after they are imposed. But the moment in which war begins, or rather the moment in which it appears likely to begin, the army must be augmented, the fleets must be fitted out, the garrisoned towns must be put into a posture of defence: that army, that fleet those garrisoned towns, must be furnished with arms, ammunition, and provisions. An immediate and great expence must be incurred in that moment of immediate danger, which will not wait for the gradual and slow returns of the new taxes. In this exigency government can have no other resources but in borrowing. National Debt.

The same commercial state of society which, by the operation of moral causes, brings government in this manner into the necessity of borrowing, produces in the subjects both an ability and an inclination to lend. If it commonly brings along with it the necessity of borrowing, it likewise brings along with it the facility of doing so.

A country abounding with merchants and manufacturers, necessarily abounds with a set of people through whose hands not only their own capitals, but the capitals of all those who either lend them money or trust them with goods, pass as frequently or more frequently than the revenue of a private man, who without trade or business lives upon his income, passes through his hands. The revenue of such a man can regularly pass through his hands only once in a year. But the whole amount of the capital and credit of a merchant who deals in a trade of which the returns are very quick may sometimes pass through his hands two, three, or four times in a year. A country abounding with merchants and manufactures, therefore, necessarily abounds with a set of people, who have it at all times in their power to advance, if they choose to do so, a very large sum of money to government. Hence the ability in the subjects of a commercial state to lend.

The progress of the enormous debts which at present oppress, and will in the long-run probably ruin, all the great nations of Europe, has been pretty uniform. In England, after the Revolution, when new connexions with Europe introduced a new system of foreign politics, the expences of the nation not only in settling the new establishment, but in maintaining long wars, as principals, on the continent, for the security of the Dutch barrier, reducing the French monarchy, settling the Spanish succession, supporting the house of Austria, maintaining the liberties of the Germanic body, and other purposes, increased to an unusual degree: insomuch that it was not thought advisable to raise all the expences of any one year by taxes to be levied within that year, lest the unaccustomed weight of them should create murmurs among the people. It was therefore the policy of the times to anticipate the revenues of their posterity, by borrowing immense sums for the current service of the state, and to lay no more taxes upon the subject than would suffice to pay the annual interest of the sums so borrowed; by this means converting the principal debt into a new species of property, transferable from one man to another at any time and in any quantity. This system indeed seems to have had its original in the state of Florence, A. D. 1344; which government then owed about 60,000l. sterling; and being unable to pay it, formed the principal into an aggregate sum, called metaphorically a *mount* or *bank*, the shares whereof were transferable like our stocks, with interest at 5 per cent. the prices varying according to the exigencies of the state. *Blackst. Commen.*

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state. This laid the foundation of what is called the *national debt;* for a few long annuities created in the reign of Charles II. will hardly deserve that name.

Nations, like private men, have generally begun to borrow upon what may be called *personal credit*, without assigning or mortgaging any particular fund for the payment of the debt; and when this resource has failed them, they have gone on to borrow upon assignments or mortgages of particular funds.

What is called the *unfunded debt of Great Britain*, is contracted in the former of those two ways. It consists partly in a debt which bears, or is supposed to bear, no interest; and which resembles the debts that a private man contracts upon account; and partly in a debt which bears interest, and which resembles what a private man contracts upon his bill or promissory note. The debts which are due either for extraordinary services, or for services either not provided for or not paid at the time when they are performed; part of the extraordinaries of the army, navy, and ordnance, the arrears of subsidies to foreign princes, those of seamen's wages, &c. usually constitute a debt of the first kind. Navy and exchequer bills, which are issued sometimes in payment of a part of such debts and sometimes for other purposes, constitute a debt of the second kind; exchequer bills bearing interest from the day on which they are issued, and navy bills six months after they are issued. The bank of England, either by voluntarily discounting those bills at their current value, or by agreeing with government for certain considerations to circulate exchequer bills, that is, to receive them at par, paying the interest which happens to be due upon them, keeps up their value, and facilitates their circulation, and thereby frequently enables government to contract a very large debt of this kind. During the great recoinage in King William's time, when the bank of England thought proper to put a stop to its usual transactions, exchequer bills and tallies are said to have sold from 25 to 60 per cent. discount, owing partly, no doubt, to the supposed instability of the new government established by the Revolution, but partly too to the want of the support of the bank of England.

When this resource is exhausted, and it becomes necessary, in order to raise money, to assign or mortgage some particular branch of the public revenue for the payment of the debt, government has upon different occasions done this in two different ways. Sometimes it has made this assignment or mortgage for a short period of time only, a year or a few years, for example; and sometimes for perpetuity. In the one case, the fund was supposed sufficient to pay within the limited time both principal and interest of the money borrowed: In the other, it was supposed sufficient to pay the interest only, or a perpetual annuity equivalent to the interest; government being at liberty to redeem at any time this annuity upon paying back the principal sum borrowed. When money was raised in the one way, it was said to be raised *by anticipation;* when in the other, *by perpetual funding*, or, more shortly, *by funding*.

In the reign of King William, when the debt began to be amassed, and during a great part of that of Queen Anne, before we had become so familiar as we are now with the practice of perpetual funding, the greater part of the new taxes were imposed but for a short period of time (for four, five, six, or seven years only), and a great part of the grants of every year consisted in loans upon anticipation of the produce of those taxes. The produce being frequently insufficient for paying within the limited term the principal and interest of the money borrowed, deficiencies arose; to make good which it became necessary to prolong the term.

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On the 31st of December 1697, the funded and unfunded debts amounted to 21,515,742l. 13s. $8\frac{1}{2}$d.; at the same time, 1714, they were 53,681,076l. 5s. $6\frac{1}{2}$d. In 1755, before the breaking out of the war, they amounted to 72,289,673l.; and on the 5th of January 1763, at the conclusion of the peace, they had accumulated to 122,603,336l. 8s. $2\frac{1}{4}$d. of funded debt, and of unfunded 13,027,589l. 2s. 2d. more. In 1775, they were very nearly 130 millions; and the last American war added upwards of 120 millions more to that enormous sum: to pay the interest of which, and the charges of management, amounting annually to nearly eight millions and a half, the extraordinary revenues elsewhere enumerated * (excepting only the land-tax and annual malt tax) are in the first place mortgaged and made perpetual by parliament. Perpetual, we say; but still redeemable by the same authority that imposed them: which, if it at any time can pay off the capital, will abolish those taxes which are raised to discharge the interest.

* See *Revenue.*

By this means, then, the quantity of property in the kingdom is greatly increased in idea compared with former times; yet, if we coolly consider it, not at all increased in reality. We may boast of large fortunes, and quantities of money in the funds. But where does this money exist? It exists only in name, in paper, in public faith, in parliamentary security: and that is undoubtedly sufficient for the creditors of the public to rely on. But then what is the pledge which the public faith has pawned for the security of these debts? The land, the trade, and the personal industry of the subject; from which the money must arise that supplies the several taxes. In these, therefore, and these only, the property of the public creditors does really and intrinsically exist; and of course the land, the trade, and the personal industry of individuals, are diminished in their true value just so much as they are pledged to answer. If A's income amounts to 100l. per annum; and he is so far indebted to B, that he pays him 50l. per annum for his interest; one half of the value of A's property is transferred to B the creditor. The creditor's property exists in the demand which he has upon the debtor, and nowhere else; and the debtor is only a trustee to his creditor for one half of the value of his income. In short, the property of a creditor of the public consists in a certain portion of the national taxes; by how much therefore he is the richer, by so much the nation, which pays these taxes, is the poorer.

The only advantage that can result to a nation from public debts, is the increase of circulation, by multiplying the cash of the kingdom, and creating a new species of currency, assignable at any time and in any quantity; always therefore ready to be employed in any beneficial undertaking, by means of this its transferable quality; and yet producing some profit even when

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when it lies idle and unemployed. A certain proportion of debt seems to be highly useful to a trading people; but what that proportion is, it is not for us to determine. This much is indisputably certain, that the present magnitude of our national encumbrances very far exceeds all calculations of commercial benefit, and is productive of the greatest inconveniences. For, first, The enormous taxes that are raised upon the necessaries of life for the payment of the interest of this debt, are a hurt both to trade and manufactures, by raising the price as well of the artificer's subsistence as of the raw material, and of course, in a much greater proportion, the price of the commodity itself. Nay, the very increase of paper circulation itself, when extended beyond what is requisite for commerce or foreign exchange, has a natural tendency to increase the price of provisions as well as of all other merchandise. For as its effect is to multiply the cash of the kingdom, and this to such an extent that much must remain unemployed, that cash (which is the universal measure of the respective values of all other commodities) must necessarily sink in its own value, and every thing grow comparatively dearer. Secondly, If part of this debt be owing to foreigners, either they draw out of the kingdom annually a considerable quantity of specie for the interest; or else it is made an argument to grant them unreasonable privileges in order to induce them to reside here. Thirdly, If the whole be owing to subjects only, it is then charging the active and industrious subject, who pays his share of the taxes to maintain the indolent and idle creditor who receives them. Lastly, and principally, It weakens the internal strength of a state, by anticipating those resources which should be reserved to defend it in case of necessity. The interest we now pay for our debt would undoubtedly be sufficient to maintain the most vigorous war that any national motives could possibly require. If indeed our ancestors in King William's time had annually paid, so long as their exigencies lasted, a far less sum than we now annually raise upon their accounts, they would not in time of war have borne so great burdens as they have bequeathed to and settled upon their posterity in time of peace; and might have been eased the instant the exigence was over.

On the whole, then, the national debt is undoubtedly a subject of vast importance, and as such it has been always considered; for much has been said and written upon it, and many schemes have been proposed at various times and by various persons for gradually removing it, it being considered by the most judicious as a most pernicious encumbrance to a commercial country. Some, we are aware, think it of vast utility; but this opinion is too eccentric, and in our estimation too feebly supported, to be convincing. The public debt is indisputably a great grievance; and every lover of his country must surely wish to see it removed: the period, however, when this blessing shall take place, if indeed it ever arrive, must at least be very distant.

We refer such as wish for farther information on this interesting topic, to those who have treated of it at full length, as Smith in his Wealth of Nations, and Sir John Sinclair in his History of the Revenue. The writings of Dr Price likewise deserve considerable attention, especially as one of his plans for the reduction of the debt has in fact been adopted, and in consequence established, by the legislature: His three plans may be found in a pamphlet by William Morgan, entitled, A Review of Dr Price's Writings on the Subject of the Finances of this Kingdom.

National Debt || Natural.

NATIVITY, or NATAL Day, the day of a person's birth. The word *nativity* is chiefly used in speaking of the saints; as, the nativity of St John the Baptist, &c. But when we say *the* Nativity, it is understood of that of Jesus Christ, or the feast of Christmas.

NATIVITY, *nativitas*, in ancient law books, signifies bondage or servitude.

NATIVITY, in *Astrology*, the theme or figure of the heavens, and particularly of the twelve houses, at the moment when a person was born; called also the *horoscope*.

Casting the nativity, or by calculation seeking to know how long the queen should live, &c. was made felony, an. 23. Eliz. c. 2.

NATIVO HABENDO, in *Law*, a writ directed to the sheriff, for a lord who claimed inheritance in any villain, when a villain was run away from him, for the apprehending and restoring him to the lord.

NATIX, in *Natural History*, a name given by some old writers to the *nerita*.

NATOLIA, the modern name of the Lesser Asia, being the most westerly part of Turkey in Asia, and consisting of a large peninsula, which extends from the river Euphrates as far as the Archipelago, the sea of Marmora, the straits of Gallipoli and of Constantinople, which separate it from Europe on the west. It is bounded on the north by the Black sea, and on the south by the Mediterranean.

NATRIX, in *Zoology*, the name of the common or water-snake, called also *torquata*, from the ring about its neck. See OPHIOLOGY *Index*.

NATRUM, or NATRON, the nitre of the ancients, one of the fixed alkalies. See SODA, CHEMISTRY *Index*.

It is found in great abundance in many parts of Asia, where the natives sweep it up from the surface of the ground, and called *soap earth*. The earliest account we have of it is in the scriptures, where we find that the salt called *nitre* in those times would ferment with vinegar, and possessed a detersive quality, so that it was used in baths and in washing. Solomon compares the singing of songs with a heavy heart, to the contrariety of vinegar and nitre: and Jeremiah says, that if the sinner wash himself with nitre, his sin is not cleansed off. These are properties that perfectly agree with this salt, but not at all with our saltpetre, which is the nitre of the moderns.

NATTER-JACK, a species of RANA, which see, ERPETOLOGY *Index*.

NATURAL, in general, something that relates to nature. See NATURE.

NATURAL Children, are those born out of lawful wedlock. See BASTARD.

NATURAL Functions, are those actions whereby the aliments are changed and assimilated so as to become a part of the body.

NATURAL, in *Heraldry*, is used where animals, fruits, flowers, &c. are blazoned with the colours they naturally have, though different from the common colours

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of heraldry: and this is to prevent their armories being accused of falsity, when blazoned with the names of colours unknown in heraldry.

Natural Note, in *Music*, is used in opposition to flat and sharp notes, which are called *artificial notes*. See Note, Scale, &c.

Natural is also used for something coming immediately out of the hands of nature: in which sense it stands opposed to *factitious* or artificial, which signifies something wrought by art. See Artificial.

Bishop Wilkins observes, that there appears a world of difference between natural and artificial things, when viewed with microscopes. The first ever appear adorned with all imaginable elegance and beauty; the latter, though the most curious in their kind, infinitely rude and unhewn: the finest needle appears a rough bar of iron; and the most accurate engraving or embossment, as if done with a mattock or a trowel.

Natural Beauty, or the beauty of natural objects, is that quality or those qualities in the works of nature, or more properly of God, which are calculated to excite pleasing sensations in the minds of all such persons of true taste as attentively observe them. It will not, we trust, be deemed improper or impertinent, therefore, to introduce a few observations on this subject, previous to our treating of natural history.—To many, it is hoped, it will appear to be a very proper introduction to that important article. "That sensibility to beauty, which, when cultivated and improved, we term taste, is universally diffused through the human species†; and it is most uniform with respect to those objects, which being out of our power, are not liable to variation from accident, caprice, or fashion. The verdant lawn, the shady grove, the variegated landscape, the boundless ocean, and the starry firmament, are contemplated with pleasure by every attentive beholder. But the emotions of different spectators, though similar in kind, differ widely in degree; and to relish with full delight the enchanting scenes of nature, the mind must be uncorrupted by avarice, sensuality, or ambition; quick in her sensibilities; elevated in her sentiments; and devout in her affections. He who possesses such exalted powers of perception and enjoyment, may almost say, with the poet,

† Dr Percival's *Moral and Literary Dissertations.*

I care not, Fortune! what you me deny;
You cannot rob me of free Nature's grace;
You cannot shut the windows of the sky,
Through which Aurora shows her bright'ning face;
You cannot bar my constant feet to trace
The woods and lawns, by living stream, at eve:
Let health my nerves and finer fibres brace,
And I their toys to the great children leave:
Of fancy, reason, virtue, nought can me bereave.

"Perhaps such ardent enthusiasm may not be compatible with the necessary toils and active offices which Providence has assigned to the generality of men. But there are none to whom some portion of it may not prove advantageous: and if it were cherished by each individual, in that degree which is consistent with the indispensable duties of his station, the felicity of human life would be considerably augmented. From this source the refined and vivid pleasures of the imagination are almost entirely derived: and the elegant arts owe their choicest beauties to a taste for the contemplation of nature. Painting and sculpture are express imitations of visible objects; and where would be the charms of poetry, if divested of the imagery and embellishments which she borrows from rural scenes? Painters, statuaries, and poets, therefore, are always ambitious to acknowledge themselves the pupils of nature; and as their skill increases, they grow more and more delighted with every view of the animal and vegetable world. But the pleasure resulting from admiration is transient; and to cultivate taste, without regard to its influence on the passions and affections, 'is to rear a tree for its blossoms, which is capable of yielding the richest and most valuable fruit.' Physical and moral beauty bear so intimate a relation to each other, that they may be considered as different gradations in the scale of excellence; and the knowledge and relish of the former should be deemed only a step to the nobler and more permanent enjoyments of the latter.

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"Whoever has visited the Leasowes, in Warwickshire, must have felt the force and propriety of an inscription which meets the eye at the entrance into those delightful grounds.

Would you then taste the tranquil scene?
Be sure your bosoms be serene:
Devoid of hate, devoid of strife,
Devoid of all that poisons life:
And much it 'vails you, in their place,
To graft the love of human race.

"Now such scenes contribute powerfully to inspire that serenity which is necessary to enjoy and to heighten their beauties. By a secret contagion, the soul catches the harmony which she contemplates; and the frame within assimilates itself to that which is without. For,

Who can forbear to smile with Nature? Can
The stormy passions in the bosom roll,
While every gale is peace, and every grove
Is melody?

"In this state of sweet composure, we become susceptible of virtuous impressions, from almost every surrounding object. The patient ox is viewed with generous complacency; the guileless sheep with pity; and the playful lamb raises emotions of tenderness and love. We rejoice with the horse, in his liberty and exemption from toil, while he ranges at large through enamelled pastures; and the frolics of the colt would afford unmixed delight, did we not recollect the bondage which he is soon to undergo. We are charmed with the song of birds, soothed with the buzz of insects, and pleased with the sportive motions of fishes, because these are expressions of enjoyment; and we exult in the felicity of the whole animated creation. Thus an equal and extensive benevolence is called forth into exertion; and having felt a common interest in the gratifications of inferior beings, we shall be no longer indifferent to their sufferings, or become wantonly instrumental in producing them.

"It seems to be the intention of Providence, that the lower order of animals should be subservient to the comfort, convenience, and sustenance of man. But his right of dominion extends no farther; and if this right be exercised with mildness, humanity, and justice, the subjects of his power will be no less benefit-

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ed than himself. For various species of living creatures are annually multiplied by human art, improved in their perceptive powers by human culture, and plentifully fed by human industry. The relation, therefore, is reciprocal between such animals and man; and he may supply his own wants by the use of their labour, the produce of their bodies, and even the sacrifice of their lives, whilst he co-operates with all-gracious Heaven in promoting happiness, the great end of existence.

"But though it be true, that partial evil, with respect to different orders of sensitive beings, may be universal good; and that it is a wise and benevolent institution of nature, to make destruction itself, within certain limitations, the cause of an increase of life and enjoyment; yet a generous person will extend his compassionate regards to every individual that suffers for his sake: and whilst he sighs

> Even for the kid or lamb that parts its life
> Beneath the bloody knife,

he will naturally be solicitous to mitigate pain, both in duration and degree, by the gentlest modes of inflicting it.

"We are inclined to believe, however, that this sense of humanity would soon be obliterated, and that the heart would grow callous to every soft impression, were it not for the benignant influence of the smiling face of nature. The count de Lauzun, when imprisoned by Louis XIV. in the castle of Pignerol, amused himself during a long period of time with catching flies, and delivering them to be devoured by a rapacious spider. Such an entertainment was equally singular and cruel: and inconsistent, we believe, with his former character, and his subsequent turn of mind. But his cell had no window, and received only a glimmering light from an aperture in the roof. In less unfavourable circumstances, may we not presume, that instead of sporting with misery, he would have released the agonizing flies, and bid them enjoy that freedom of which he himself was bereaved?

"But the taste for natural beauty is subservient to higher purposes than those which have been enumerated; and the cultivation of it not only refines and humanizes, but dignifies and exalts the affections. It elevates them to the admiration and love of that Being who is the author of all that is fair, sublime, and good in the creation. Scepticism and irreligion are hardly compatible with the sensibility of heart which arises from a just and lively relish of the wisdom, harmony, and order subsisting in the world around us: and emotions of piety must spring up spontaneously in the bosom that is in unison with all animated nature. Actuated by this divine inspiration, man finds a fane in every grove; and glowing with devout fervour, he joins his song to the universal chorus, or muses the praise of the Almighty, in more expressive silence. Thus they

> "Whom Nature's works can charm, with God himself
> Hold converse: grow familiar, day by day,
> With his conceptions; act upon his plan;
> And form to his the relish of their souls."

On the whole, then, it certainly appears, that the advantages resulting from a taste for natural beauties are great and important: it is equally certain, that as it is useful, so it is a continual source of real enjoyment; for a more rational pleasure cannot possibly occupy the attention or captivate the affections of mankind, than that which arises from a due consideration of the works of nature. Pleasure, we know, is a necessary ingredient in human life, in order in some measure to counterbalance the pains, the evils, and listlessnesses, which are at times perhaps unavoidable, and in order to render life tolerable. It is the part then of the moralist, and it has been frequently his business, to point out and recommend such pleasures as are highly gratifying, and are yet perfectly innocent. The Spectator, whose works will be admired as long as the language in which they are written is understood, recommends strongly and elegantly the pleasure of a garden; and a later writer †, of no common degree of merit, and of very considerable fame, has an essay on the same subject, from which we shall select a few observations, and so conclude the article. "Not he alone (says this elegant writer) is to be esteemed a benefactor to mankind, who makes an useful discovery; but he also who can point out and recommend an innocent pleasure. Of this kind are the pleasures arising from the observation of nature; and they are highly agreeable to every taste uncorrupted by vicious indulgence. Rural scenes of almost every kind are delightful to the mind of man. But the misfortune is, that the greater part are hurried on in the career of life with too great rapidity to be able to give attention to that which solicits no passion. The darkest habitation in the dirtiest street of the metropolis, where money can be earned, has greater charms with many than the groves of Hagley.

† Dr Knox.

"The patron of refined pleasure, the elegant Epicurus, fixed the seat of his enjoyment in a garden. He was of opinion, that a tranquil spot, furnished with the united sweets of art and nature, was the best adapted to delicate repose. And even the severer philosophers of antiquity were wont to discourse in the shade of a spreading tree, in some cultivated plantation. It is obvious, on intuition, that nature often intended solely to please the eye in her vegetable productions. She decorates the floweret that springs beneath our feet in all the perfections of external beauty. She has clothed the garden with a constant succession of various hues. Even the leaves of the tree undergo a pleasing vicissitude. The fresh verdure which they exhibit in the spring, the various shades which they assume in summer, the yellow and russet tinge of autumn, and the nakedness of winter, afford a constant pleasure to a lively imagination. From the snowdrop to the moss rose the flower garden displays an infinite variety of shape and colour. The taste of the florist has been ridiculed as trifling; yet surely without reason. Did nature bring forth the tulip and the lily, the rose and the honeysuckle, to be neglected by the haughty pretender to superior reason? To omit a single social duty for the cultivation of a polyanthus were ridiculous as well as criminal; but to pass by the beauties lavished before us, without observing them, is no less ingratitude than stupidity. A bad heart finds little amusement but in a communication with the active world, where scope is given for the indulgence of

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malignant passions; but an amiable disposition is commonly known by a taste for the beauties of the animal and the vegetable creation." In short, since the world was made for our use, since the beauties of nature are alike displayed before all men, and since they are unquestionably an inexhaustible fund of innocent amusement; that subject must be of vast importance which enables us to relish them properly.

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NATURAL HISTORY.

1 Definition.

THE objects of nature may be considered under two points of view; 1st, With respect to their form, structure, habits, and individual properties when viewed in a state of inactivity; 2dly, With respect to the mutual changes which they produce when made to act on each other. Hence the study of nature may be divided into two parts, NATURAL HISTORY and NATURAL SCIENCE; the former considering bodies in comparatively an inactive state, the latter in a state of mutual action.

NATURAL HISTORY, then, is that part of natural knowledge which teaches us to distinguish and describe the objects of nature, to examine their appearance, structure, properties and uses, and to collect, preserve, and arrange them (A).

2 Immensity of nature's works.

I. When we take a general survey of the objects with which we are surrounded, we are bewildered amidst the number and variety that are every where presented to our view. The air, the woods, the fields, the waters, teem with myriads of animals; a large proportion of the earth's surface is covered with a green mantle of luxuriant herbage, interspersed with plants and flowers of a thousand varied tints; and when we search below this, when we explore the cloud-capt mountain, the gloomy mine, the sequestered cavern, or the rocky cliff, we discover a great variety of mineral substances, either piled into irregular masses, or lying in uniform beds or layers, disposed in veins or seams, or scattered at random through the other stony matters.

To the casual observer, the number and variety of these objects would appear almost infinite. He would consider it equally impossible to enumerate them, as to number the stars, or count the sands on the sea shore. This idea, however, arises from his seeing them in confusion and disorder. The naturalist, by separating them into those groups or classes, in which they often naturally present themselves, has succeeded not only in distinguishing the several kinds from each other, but even in guessing pretty accurately at the number of species that have hitherto been discovered.

There are two objects which should principally occupy the attention of the naturalist: 1st, To classify natural substances; 2dly, To examine their structure.

3 Classification.

The number of natural productions being confessedly very great, it is necessary to find out some means of distinguishing them from each other, and of recognizing them on seeing them anew. These means are the peculiarities, or the assemblages of peculiarities, that exclusively belong to each body. Now there is scarcely any substance that has a simple character, that is, which can be distinguished from every other substance by any one of its properties singly. It is only by the combination of several of these properties that we can distinguish an object from others which resemble it in possessing some one or more of those very properties; and the more numerous the species we compare, the more necessary it becomes to bring their properties together, in order to assign to each a character that may distinguish it from the rest. Hence to distinguish a species, considered independently from all others that exist in nature, it is necessary to express in its character almost the whole of its properties; and the more of these we take into the character, the more complete will be our description of the object. But no man can acquire a sufficiently accurate knowledge of all natural objects to enable him to give a complete description of them: human life is too short to admit of the completion of such a task. All that can be expected from our limited faculties is to acquire a general knowledge of natural objects, confining our principal attention to such as possess some striking qualities, or appear convertible to the useful purposes of life.

4 *Methods and systems.*

To gain this end, two modes of procedure have been adopted by naturalists. According to the first mode, we employ characters that proceed by degrees from particulars to generals. We begin by comparing together a certain number of species that bear the nearest relation to each other. In drawing the characters of these species, it is requisite to express only those differences, which, on a supposition that they are the most nearly related, form but a small part of their properties; a number of species thus brought together constitutes what is called a *genus* or *tribe*.

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(A) Some writers divide natural history into *general* and *particular*, which are thus defined by Cuvier. *General natural history* considers under a single point of view, all natural bodies, and the common result of all their actions in the great whole of nature. It determines the laws of coexistence of their properties; it establishes the degrees of resemblance that exist between different bodies, and classes them according to these degrees. The *Particular natural history* of any body, to be perfect, should comprehend, 1st, The description of all the sensible properties of that body, and of all its parts; 2d, The mutual relations of these parts, the motions which they produce, and the changes which they undergo while they remain united; 3d, The active and passive relations of this body with every other body in the universe; and 4th, The explanation of all these phenomena. See *Tableau Elementaire d'Histoire Naturelle.*

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The remainder of these properties which are common to all the species of the genus combine to form the character, or rather the description, of the genus, distinguishing it from all those which might be formed by bringing together other species; but the number of these common properties being still very considerable, we repeat the same means in order to reduce the characters of the *genera* to smaller terms. We compare together only those genera which most nearly resemble each other, and the generic characters now employed must only express those differences which form but a small part of their common properties. Those properties, which are common to all the genera, compose a character that distinguishes this assemblage or group from all other groups of genera. Such an assemblage of genera is called an *order*.

Repeating the same operation, and bringing together such orders as are most nearly allied, we form a more general assemblage, called a *class;* and again uniting a certain number of classes, we form a higher division, to which naturalists have given the name of *kingdom*: this chain of divisions in which the higher links comprehend the lower, forms what is called a *method*. The other mode of procedure is to rise gradually from generals to particulars, beginning with the slightest and most obvious differences, thus forming the first division or kingdom; dividing each kingdom into classes, each class into orders, each order into genera, each genus into species, and each species into varieties. This descending series constitutes what is called a *system*, and is that which has been generally adopted by naturalists.

5 Illustration.

To illustrate this systematical classification of natural objects, let us select a familiar example. Among the various creatures that pass under our observation, a great number are possessed of life, of sensation, and voluntary motion; these we call *animals*, and of these we form the *animal kingdom*. On examining various groups of animals, we find that many have four extremities, and suckle their young by means of teats; these we call *quadrupeds* or *mammalia*. We have thus formed a *class of animals*. Again we find that of the mammalia some have hoofed feet and blunt fore-teeth, and feed almost entirely on vegetables. These will constitute an order of the class of mammalia, to which Linnæus has given the name of *bellucæ*. Of this order a certain number of animals agree in having six fore-teeth in both jaws, and form a genus or tribe distinguished by this particular from the other animals of the same order, and commonly called the *horse* tribe. Lastly, In this tribe we find one species that has solid hoofs, a tail bristly at the end, an upright mane, and a black cross on the shoulder of the male. This species is the common *ass*.

6 Division of nature into kingdoms examined.

In framing an artificial system of natural history, most writers have agreed on the division of natural bodies into kingdoms, proceeding on the supposition that those marks which are to distinguish the objects of one kingdom from those of another are sufficiently fixed and certain.

Let us examine for a little how far this supposition agrees with nature's works as we find them.

The division of natural objects commonly adopted is into three kingdoms; the animal, vegetable, and mineral kingdoms. This division has been almost universally received as perfectly consistent with nature; and is by most persons thought to be so clear and distinct, that they suppose it impossible to mistake in referring any particular object to its proper kingdom. This arises from their having noticed only such objects as bear evident marks of the division to which they belong; but if we draw their attention to a variety of other individuals, they will acknowledge themselves to be incompetent to the decision, or will erroneously refer to one division, what has, after accurate examination, been determined to belong to another.

Classification.

There is one whole class of productions, called *zoophytes* by naturalists, which seem to form the connecting links between the different kingdoms. They are animals of the polypus kind, mostly covered with a calcareous crust, differing little in composition from the shells of lobsters, shrimps, and other shell-fish, and formed like them from an exudation or secretion on the surface of their bodies. These polypi are connected together by thousands, or even millions, and assume a great variety of appearances according to their arrangement: the same species, however, always assuming the same, or very nearly the same appearance. Some are connected together in form of stem and branches, as the *flustræ*, *sertulariæ*, *corallines* and others; many of which have their offspring in the egg state attached to them, and so situated as to bear exact resemblance to the seed-vessels of plants. These are altogether so like to many of the sea plants, as to be generally confounded with them, under the title of sea-weeds; but the attentive naturalist may, by examining them in their natural state, perceive the tentacula or feelers of each polypus extended in its search for food, and hastily retracting within its shell upon the least alarm. Many of this description are found attached to oysters or other shell-fish; and often to stones and pebbles which are covered or occasionally wetted by the sea.

Other zoophytes assume less regular figures, and are much more firm and solid, resembling the productions of the mineral kingdom. Madrepores and millepores, called often *brainstones*, are of this kind. At first sight they look very like stones and pebbles, or like pieces of chalk or marble, but on an accurate inspection, any one may perceive marks of an organic structure; and when they are in a recent state, may detect the inhabitants of their numerous cells.

The above examples will suffice to prove, how insufficient is either a hasty examination or the judging by similarity of appearance, for determining to what kingdom of nature any particular object belongs. But there are many other productions to which few persons could without hesitation assign their places: For instance, where would we arrange the green powdery substance so common on paling; the spotted and streaked appearance on stones; the mould on cheese, or the green jelly-like matter that floats on the surface of the stagnant waters? Naturalists in general have assigned these productions to the vegetable kingdom; but Sennebier and a few others have maintained that some of them are animals.

According to some writers, the most philosophical notion which we can form on this subject is, that the division of natural objects into kingdoms is artificial, and that Nature, acknowledging no such bonds, passes imperceptibly from the animal to the vegetable, and from the

Classification.

the vegetable to the mineral world, without defining where one ceases or where the next begins.

As the appearances of natural productions are insufficient, so are their properties and powers, for determining which are animals or which vegetables, according to the received acceptation of the terms. If locomotion is allowed to be the characteristic of an animal, where shall we place the oyster, or the zoophytes of which we have just been speaking, or where some species of *ulva* and *conferva*, plants that swim about detached in water? If feeling or sensation be the test, who shall decide, that the sensitive plant (*mimosa pudica*), possessess it not? and who determine that the *leaves* of the fly-trap, (*Dionæa muscipula*), when they contract, and catch the fly as soon as it alights, do not feel the despoiler that comes to rob it of its honey? *

* *Skrimshire's Essays on Natural History*, vol. i.

Though these and similar objections may certainly be made to the artificial division of nature's works into kingdoms, yet it is convenient to have such a division; and even the very difficulty of establishing to which kingdom any object belongs, is an additional spur to the genius and industry of the naturalist.

7 Division of natural bodies into *organized* and *inorganic*.

The most natural division of the works of nature is that which distinguishes them into organized and *inorganic* bodies; and on the whole, we have seen no attempt to establish the differences between these so successful as that adopted by M. Dumeril in his late scientific work, *Traité Elementaire d'Histoire Naturelle*. "Some objects, says he, as animals and plants, have formerly constituted a part of other individuals, similar to themselves, from which they have been separated at a certain period, under the form of eggs, of germs, or of little living creatures; and their existence is evidently owing to this generation; they are *born*. Others, on the contrary, as stones, salts, water, may be formed by certain circumstances, and even by ourselves at pleasure. They have not necessarily made a part of other similar bodies; their existence seems to depend on certain fortuitous circumstances, that have produced the approximation of their constituent principles, and their origin might be referred to attraction. These bodies are *formed*. Vegetables and animals, in increasing their size, only develope themselves. Whatever may be their minuteness, we shall, on a careful examination, find them already formed, with their parts requiring only to be evolved. Their increase proceeds from within outwards by *intus-susception*. Stones, and a great many other bodies, are augmented only by the same matter from which they are produced; their growth takes place always from without, by a sort of aggregation.

"As the increase of the bodies which compose these two great subdivisions is not alike in both, a duration very different ought to be the result of these dissimilarity. In fact, minerals are susceptible of indefinite increase, and their end is always indeterminate; it is vague, and depends on the circumstances under which they are placed. Plants and animals ought, from the same circumstances which favoured their developement, to stop when their extension has been carried to the highest degree, so that the end or death of these bodies is fixed and necessary.

"The masses in which stones and other similar bodies generally present themselves, are angular, insulated, and very variable in their size. The individuals which we call plants and animals, have always, and necessarily, a form that is constant, for the most part rounded and symmetrical, and their extension is limited within certain bounds. Classification.

"There is this great difference between these bodies; that those which increase by aggregation may be divided into molecules, or parts infinitely small, bearing a very near resemblance to the mass from which they were taken; while in those which develope themselves, no portion can be taken away and exist by itself, at least unless it develope new parts, which replace those that are wanting.

"The bodies which do not develope themselves, are in general formed of fluids or solids which remain constantly in the same points; they are composed of very few elements, which may be separated and again reunited. The bodies which develope themselves, on the contrary, are essentially composed of solids and fluids, which are always changing, and in a state of renovation; they have always, and from necessity, more or less consistence, they are penetrated and augmented by fluids, and after being decomposed they can never be formed again such as they were before.*."

* *Dumeril Traite Elem.* tom i. p. 5.

8 Division of natural history.

For the more convenient study of natural history, the whole subject may be divided into five great branches, viz. Meteorology, Hydrography, Mineralogy, Botany, and Zoology.

9 Meteorology.

1. Meteorology includes the description of all those phenomena which take place in the atmosphere that surrounds our globe. In the present work it is considered under the articles METEOROLOGY, METEOROLITE, *Atmospheric* ELECTRICITY, CLOUD, MOON, *Influence of*, &c.

10 Hydrography.

2. Hydrography comprehends the natural history of the sea, of rivers, lakes, and other collections of water that make up so large a part of the earth. Much of this subject will be found treated of under the article RIVER, and various parts of it have been discussed under CHEMISTRY and MINERALOGY.

11 Mineralogy.

3. Mineralogy is that part of the subject which treats of the solid inorganic bodies that are found on the surface or in the bowels of the earth. It has been considered under the articles GEOLOGY and MINERALOGY.

12 Botany.

4. Botany comprehends the natural history of vegetables. See BOTANY.

13 Zoology.

5. Zoology includes the natural history of all animated beings, and is subdivided into many subordinate classes.

These classes are different in number and denomination, according to the different systems of naturalists. Linnè, whom we have principally followed in this work, has arranged animals under six classes: viz. 1. *Mammalia*, or those animals which suckle their young at *mammæ* or paps; see MAN, MAMMALIA and CETOLOGY. 2. *Aves*, or birds; see ORNITHOLOGY. 3. *Amphibia*, or those animals which can live either on land or in water; see ERPETOLOGY and OPHIOLOGY. 4. *Pisces*, or fishes; see ICHTHYOLOGY. 5. *Insecta*, or insects; see ENTOMOLOGY. And 6. *Vermes*, or worms; see HELMINTHOLOGY and CONCHOLOGY.

14 Cuvier's arrangement.

Later naturalists have divided animals into a greater number of classes, and have subdivided these differently. Of these arrangements, that of M. Cuvier seems the most deserving of notice. After considering man, whom he very properly distinguishes from the other mammalia by allotting to him a separate book, he divides the rest of

Classification. of the animal kingdom into nine classes, viz. MAMMIFEROUS animals, BIRDS, REPTILES, FISHES, MOLLUSCA, WORMS, CRUSTACEOUS animals, INSECTS and ZOOPHYTES.

We have already given an outline of four of these classes, viz. of the MAMMIFEROUS animals, under MAMMALIA, and of MOLLUSCA, WORMS and ZOOPHYTES, under HELMINTHOLOGY. To complete our view of Cuvier's arrangement, we shall here add an outline of the remaining five classes.

15 Of birds. Cuvier divides birds into five orders, viz. RAPACIOUS birds or ACCIPITRES, PASSERINE birds, CLIMBERS or SCANSORES, GALLINACEOUS birds, WADERS or GRALLÆ, and ANSERINE birds.

1. The RAPACIOUS birds have short feet, toes furnished with strong claws, and a hooked bill. They are subdivided into three sections; viz. *Nudicolles*, having the head and part of the neck without feathers; containing the vulture tribe. *Plumicolles*, having the head covered with feathers and a cere at the base of the bill, containing the falcon tribe; including *Griffons*, *Eagles*, *Sparrow-hawks*, *Buzzards*, *Kites* and *Falcons*. *Nyeterides*, having the head flattened backward from the front and the eyes directed forward; containing the *owl* tribe.

2. The PASSERINE birds are distinguished by having four toes, three before and one behind, with the external toes wholly or partially united. They are subdivided into seven sections: viz. *Crenirostres*, having the bill grooved towards the end of the mandible; containing the Shrikes, Flycatchers, Thrushes, Chatterers and Tanagers. *Dentirostres*, having a bill with notched edges; containing the Plant-clippers, Motmots, and Hornbills. *Plenirostres*, having the bill straight, strong, compressed and without a groove; containing the Grakles, Crows, Rollers, and Birds of Paradise. *Conirostres*, having the bill conical; containing the Orioles, Stares, Grosbeaks, Sparrows, and Buntings. *Subulirostres*, having the bill slender like an awl; containing the Titmice, Manakins, Larks, and Wagtails. *Planirostres*, having the bill short, flattened horizontally, and opening very wide; containing the Swallows and Goat-suckers. *Tenuirostres*, having the bill slender, elongated and solid; containing the Nuthatches, Creepers, Humming birds, Hoopoes, Bee-eaters, King's-fishers and Todys.

3. The CLIMBERS have two toes before and two behind. They are subdivided into two sections; viz. *Cuneirostres*, having a slender bill; containing Jacamars, Wood-peckers, Wry-necks, and Cuckoos. *Levirostres*, having the bill thick and light; containing the Anis, Touracoes, Musophages, Curucuis, Barbets, Toucans, and Parrots.

4. The GALLINACEOUS birds have the front toes united at their base by a short membrane. They are subdivided into two sections, viz. *Alectrides*, having common wings fitted for flying; containing the Pigeons, Grouse, Peacocks, Pheasants, Pintados, Turkeys, Curassows, Guans, Bustards. *Brevipennes*, having wings too short for flight; containing the Ostrich, Cassowary and Dodo tribes.

5. The WADERS have elevated and naked tarsi and the two outer toes united. They are subdivided into five sections, viz. *Brevirostres*, having the bill short and thick; containing the Trumpeters, Screamers, Secretaries, Boat-bills, and Flamingos. *Cultrirostres*, having the bill long, strong, and like a knife; containing the Herons, Jabirus and Ibisses. *Latirostres*; having the bill long, weak, and flattened horizontally; containing the Spoonbills. *Longirostres*, having the bill slender, long and weak; containing the Avosets, Plovers, Lapwings, Phalaropes, and Woodcocks. *Pressirostres*, having the bill middle-sized and compressed, containing the Oyster-Catchers, Rails, Coots and Jacanas. Classification.

6. The ANSERINE birds have the toes united by broad membranes. They are subdivided into four sections, viz. *Pennipedes*, having all the four toes united; containing the Pelicans, Tropic birds and Darters. *Macropteres*, having the thumb free, the bill not indented, and very long wings; containing the Terns, Gulls, Skimmers, Petrels and Albatrosses. *Serrirostres*, having the thumb free, the bill broad and serrated, and wings of a moderate size; containing the Ducks and Mergansers. *Brachypteres*, having the thumb either free or wanting, the bill not serrated, and the wings very short, containing the Grebes, Auks and Manchots.

16 Of reptiles. The AMPHIBIA or REPTILES are divided into two orders, as follows.

1. Those that have a heart with two auricles. This order is subdivided into two sections, viz. *Chelonia*, having a back shell and the jaws invested with horn, containing the Tortoise tribe, including Turtles and Tortoises. *Sauria*, having a scaly body and teeth; containing the Lizard tribe, including the Crocodiles, Guanas, Dragons, Lizards, Skinks, and some others.

2. Those that have a heart with one auricle. This order is also subdivided into two sections, viz. *Ophidia*, having a scaly body, no feet, and always without branchiæ; containing the tribes of Anguis, Amphisbæna, Cæcilia, Acrocordon, Angaha, Coluber or *Snake*, Boa, and Crotalus or *Rattle-Snake*. *Batraehia*, having a naked skin, feet and branchiæ in the young animals; containing the Frogs, Salamanders, and (according to Cuvier's original table) the Siren.

17 Of fishes. The fishes are divided into two orders, CARTILAGINOUS and BONY fishes.

1. Those which have a Cartilaginous skeleton are divided into two sections, viz. *Chondropterygii*, with fixed branchiæ; containing the Lampreys, Hags, Rays, Dog-fish and Sea-monsters. *Branchiostegi*, with free branchiæ; containing the tribes Batrachus or *American Toad-fish*, Polyodon, Accipenser or *Sturgeons*, Pegasus, Syngnathus or *Pipe-fish*, Centriscus or *Bellows-fish*, Balistes or *Horned-fish*, Ostracion or *Trunk-fish*, Tetraodon or *Sun-fish*, Oveides, Mola or *Moles*. Diodon or *Porcupine-fish*, Lophius or *Frog-fish*, and Cyclopterus or *Lump-fish*.

2. The fishes with a bony skeleton are subdivided into four sections, viz. *Apodes*, having no ventral fins; containing the tribes of Muræna or *Eels*, Gymnothorax, Synbranchus, Sphagebranchus, Gymnotus or *Electric-eels*, Trichiurus, Gymnecterus, Ophidium, Ammodytes, or *Sand-eels*; Anarrhichas, or *Sea-wolves*; and Xiphias or *Sword-fish*. *Jugulares*, having the ventral fins situated before the pectoral; containing the Haddocks, Blennys, Hunch-back, Dragonets, Sea-dragons, and Star-gazers. *Thoracici*, with the ventral fins situated below the pectoral; containing the Bull-heads, Scorpions, Gurnards, Gobys, Surmullets, Mackerel, Stickle-backs, Long-tails, Lonchiurus, Johnes, Sciænes, Dorees, Stromateus, Theuthis, Chætodon, Dorados, Bodians,

Classification. Bodians, Holocentrus, Lutiens, Perches, Anthias, Epinelephus, Wrasses, Breams, Scares, Flounders, Sea-serpents, Lepidopus, and Remoras. *Abdominales*, with the ventral fins situated behind the pectoral; containing the Mormyrus, Carps, Mullets, Flying-fish, Polynemus, Herrings, Atherines, Argentines, Salmons, Pikes, Loches, Anablapes, Silurus, Platysomatus, Armed-fish, Cuirass-fish, Amia, Acanthonotus, and Fistularia, or *Tobacco-pipe-fish*.

18 Of crustacea. The CRUSTACEA are divided into two orders, as follows:

1. *Monoculi*, containing the tribes of Limulus, Calygus, Apus, Cyelops, and Polyphemus.

2. *Cercvisses*, or *Crabs*, containing the tribes of Cancer, Inachus, Pagurus, Astacus, Palinurus, Scyllarus, and Squilla.

19 Of insects. The INSECTS are distributed by Cuvier under two general orders, viz. Those with jaws, and those without jaws.

1. *Insects* with jaws are arranged under five sections, viz. GNATHAPTERA, NEUROPTERA, HYMENOPTERA, COLEOPTERA, and ORTHOPTERA. The GNATHAPTERA, have no wings, and are subdivided into *Polygnathes*, having several pairs of jaws, containing the tribes of Physodes, Oniscus, and Cymothoa; *Millepedes*, with two jaws and feet at each ring of the body, containing the tribes of Julus and Scolopendra; *Araneides*, having the head joined to the corselets, eight feet, and abdomen without feet; *Setieaudes*, having the head distinct, six feet, and abdomen terminated by silken threads; *Ricinus*, with the head distinct, six feet, and the abdomen naked. The NEUROPTERA have four reticulated wings, and are subdivided into *Odonates*, having the mouth covered with the lip, and the wings extended during repose; *Tectipennes*, with the mouth salient, and wings hidden below the body during repose; *Agnathes*, with a very small mouth, and no mandibles. The HYMENOPTERA have four veined wings, and of these some have the abdomen joined to the thorax by a pedicle; as the *Mellites*, having the lip prolonged into a trunk; the *Duplipennes*, having the upper wings folded lengthwise; the *Chrysides*, having the antennæ bent, and the abdomen hollow below; the *Anthophiles*, with the antennæ filiform, wings not folded, abdomen round, and lips short; the *Trouisseurs*, with setaceous antennæ, of 12 or 13 joints, rolling up spirally; the *Myrmeges*, with setaceous bent antennæ, and a rounded abdomen; the *Insectirodes*, with bent antennæ of 30 joints, and a prominent sting; *Cynipes*, with filiform antennæ and a spiral sting. Others of this section have the abdomen sessile, as the *Uroceri*, with palpæ scarcely apparent, and a very prominent sting, and the *Tenthredos* with very prominent palpæ and a serrated sting. The COLEOPTERA have four wings, the uppermost of which are hard, and the lower fold transversely: they have either six palpæ, as the *Carnassiers*, with filiform or setaceous antennæ; or four palpæ; and of these latter some have the tarsus five-jointed, as the *Lamellicornes*, with clavated antennæ, having the club lamellated; the *Clavicornes*, with the antennæ either perfoliated or solid; the *Brachelytcres*, with moniliform antennæ and short elytra; the *Woodpiercers*, with filiform antennæ and hard elytra; and the *Apalytres*, with filiform antennæ and soft elytra. Others have the tarsi four or five-jointed; as the *Lucifuges*, with variable antennæ and hard elytra; and the *Blistering-flies*, with variable antennæ and soft elytra. Others again have the tarsi four-jointed; as the *Rostricornes*, with antennæ on the beak; the *Wood-eaters*, with setiform antennæ; the *Teretiforms*, with clavated antennæ, and a body often cylindrical, and the club solid; the *Planiforms*, with granulated antennæ and a flattened body; and the *Herbivori*, with filiform or moniliform antennæ and a swollen body. A few have the tarsi three-jointed, as the *Coccinellæ*. The ORTHOPTERA have four wings, the upper hard and the lower folded longitudinally. They include the *Forficulæ*, having the anus terminated by a forceps; the *Blattæ*, with a flattened body and the head retiring below the corselet; the *Mantis* and *Spectres*, with a very long corselet; and the *Leapers*, with cylindrical body and long hinder legs formed for jumping. Classification.

2. The INSECTS without jaws are subdivided into HEMIPTERA, LEPIDOTERA, DIPTERA, and APTERA. The HEMIPTERA have four wings frequently crossed, and a jointed beak; and include the *Frontirostres*, having the beak rising from the fore part of the head; the *Collirostres*, with the beak appearing to grow from the neck; and the *Planipennes*, with the wings not crossed and spreading. The LEPIDOPTERA have four wings covered with scales and a spiral trunk; they include the *Butterflies*, with the antennæ terminated by a solid mass; the *Hesperiæ*, with the antennæ curved at their extremity; the *Fusicornes*, with the antennæ swelling towards the middle, and the *Seticornes*, with setaceous antennæ. The DIPTERA have only two wings; and include the *Hydromies*, with filiform or plumose antennæ and a trunk; the *Sarcostomes*, with a fleshy retractile trunk, terminated by two lips; the *Sclerostomes*, with very short antennæ, a horned projecting sucker, but no trunk; and the *Gad flies*, with short antennæ, and neither sucker nor trunk. The APTERA have no wings: they include the *Parasitical* insects, or *Fleas*, *Lice*, and *Mites*.

20 The notion of a chain of beings examined. It is not surprising that naturalists of taste and genius, from the gradation that seems to take place among the works of nature, should have been led to form the notion that there exists in nature a regular series or *chain* of beings, the links of which, if we could discover them all, would be found to resemble each other so nearly, as only to exhibit to the superficial observer a few shades of difference. *Natura non per saltum movet*, has become a sort of axiom in natural history.

The notion of a *chain* of *being* is alluring, and does not want arguments in its favour. The Esquimaux Indian, or the inhabitant of Terra del Fuego, seems scarcely superior in form, and very little in intellect, to the Oran Otan; the *Platypus*, the flying *Lemur*, flying Squirrels, and, still more, the Bats, appear to form the connecting links between quadrupeds and birds; while the Seals, the *Walrusses*, and the whole order of *Cete*, connect the former with the fishes. In this latter class, the Flying Fish, in its capability of supporting itself in the air, seems to approach the feathered tribes, while some of these, as the Penguins, in their habits and manner of life, bear some distant resemblance to fishes. Again, the Siren and the Eels so nearly resemble each other, that it has been disputed whether the former should be reckoned among the *Amphibia* or the *Fishes;* while one species of Lizard, (*Lacerta lumbricoides*), is so like an earth-worm, as apparently to connect the *Amphibia* and the *Vermes*. Farther, the diminutive Humming-bird (*Trochilus exilis*), and the

Classification.

Humble Bee, (*Apis terrestris*), are so nearly alike, both in size and manner of life, as to form no very exceptionable links of union between the birds and insects.

If we compare the vegetable tribes with some of the inferior classes of animals, we shall perceive many points of resemblance, which may seem to indicate a continuance of the same chain. Besides the *Mimosa pudica* and *Dionæa muscipula*, already mentioned, the *Hedysarum gyrans*, or moving plant, is a remarkable instance of the mobility of vegetables; the carrion flower (*Stapelia hirsuta*), and some species of *morel*, bear the odour of putrid animal substances; while on the other hand, the *Mantis siccifolia* might be mistaken for a dried leaf; several species of *Pennatula* (sea pens) and *Sertularia*, for ferns; the *Madrepora fungites* (mushroom madrepore), for a petrified mushroom; and the *Tubularia magnifica*, and *Actiniæ*, when expanded, for the most beautiful full-blown flowers.

Lastly, on comparing the mineral kingdom with the classes of organized beings, we find several so nearly resembling stones, as scarcely to be distinguished from them.

Though the view which we have given above, of the circumstances that have led naturalists to form the idea of a regular chain of beings, is specious; it will not bear the scrutiny of a strict examination. The resemblances which we have pointed out, are more apparent than real; and anatomy and chemistry, added to a more accurate acquaintance with the works of nature, have proved, that those links which, to superficial observers, appear most allied, are yet separated by considerable chasms. In fact, if we were to admit these resemblances as ever so accurate, they would lead us to form, not one chain, but many.

21 Number of species in nature.

It must be considered as a very difficult, though a very curious problem, to ascertain the number of species at present known throughout the several subdivisions of nature. From the different modes in which different naturalists have distributed the objects of their research, and from the additions that are perpetually made to our knowledge, it may be impossible to fix the precise number of known species at any given time; but we may make a tolerably near approximation to the truth; and this we shall now attempt, going through the several *kingdoms*, *classes*, and *orders*, as they have been treated of in the former parts of this work.

22 Animals.

I. IN THE ANIMAL KINGDOM.

A. Man,		5 species.	
B. Mammalia.			*See *Mammalia.*
1. Primates,	100*		
2. Bruta,	30*		
3. Feræ,	184*		
4. Glires,	124*		
5. Pecora,	82*		
6. Belluæ	13*		
7. Cete,	25†		† See *Cetology.*
		558 species.	
C. Birds.			
1. Accipitres,	259		
2. Picæ,	757		
3. Anseres,	279		
4. Grallæ,	346		
5. Gallinæ,	127		
6. Passeres,	1038		
		2806 ‡	‡ *Turton.*
D. Amphibia.			
1. Reptiles	176		
2. Serpents,	225		
		401 §	§ See *Erpetology.*
E. Fishes.			
1. Apodes,	40		
2. Jugulares,	52		
3. Thoracici,	443		
4. Abdominales,	200		
5. Brancheostegi,	82		
6. Chondropterigii,	70		
		887 **	** *Turton.*
F. Insects.			
1. Coleoptera,	5011		
2. Hemiptera,	1687		
3. Lepidoptera,	2900		
4. Neuroptera,	1097		
5. Hymenoptera,	1573		
6. Diptera,	1026		
7. Aptera,	744		
		14,038 ††	†† *Turton.*
G. Worms.			
1. Intestina,	406‡‡		‡‡ See *Helminthology.*
2. Mollusca,	433‡‡		
3. Testacea,	2672*		* See *Conchology.*
4. Zoophyta,	489‡‡		
5. Infusoria,	229‡‡		
		4229	

So that the number of species in this kingdom may be estimated at about 22,924, or in round numbers about 23,000 (B).

II. IN THE VEGETABLE KINGDOM.

23 Vegetables.

A. Monandria.		
1. Monogynia,	73	
2. Digynia,	10	
		83 species.
B. Diandria.		
1. Monogynia,	374	
2. Digynia,	5	
3. Trigynia,	52	
		431
C. Triandria.		
1. Monogynia,	477	
2. Digynia,	546	
3. Trigynia,	32	
		1055

(B) The numbers here given differ in several instances from those which we have seen in some late works on this subject. Thus, M. La Cépède, in a note to the discourse delivered by him at the close of his course of Natural History, states the numbers of some classes as follows: *Mammalia*, 416 species; *Birds*, 2534; *Reptiles*, 125; *Serpents*, 180; *Fishes*, 992; in all 4247.

Classification.

D. TETRANDRIA.
1. Monogynia, 527
2. Digynia, 14
3. Trigynia, 521
4. Tetragynia, 51
593 species.

E. PENTANDRIA.
1. Monogynia, 1537
2. Digynia, 652
3. Trigynia, 121
4. Tetragynia, 8
5. Pentagynia, 173
6. Decagynia, 1
7. Polygynia, 2
2494

F. HEXANDRIA.
1. Monogynia, 699
2. Digynia, 5
3. Trigynia, 69
4. Hexagynia, 2
5. Polygynia, 10
785

G. HEPTANDRIA.
1. Monogynia, 25
2. Digynia, 3
3. Tetragynia, 2
4. Heptagynia, 1
31

H. OCTANDRIA.
1. Monogynia, 377
2. Digynia, 11
3. Trigynia, 95
4. Tetragynia, 10
493

I. ENNEANDRIA.
1. Monogynia, 40
2. Trigynia, 8
3. Hexagynia, 1
49

K. DECANDRIA.
1. Monogynia, 452
2. Digynia, 131
3. Trigynia, 142
4. Pentagynia, 205
5. Decagynia, 7
927

L. DODECANDRIA.
1. Monogynia, 100
2. Digynia, 6
3. Trigynia, 138
4. Tetragynia, 7
5. Pentagynia, 6
6. Dodecagynia, 14
271 species.

M. ICOSANDRIA.
1. Monogynia, 133
2. Digynia, 16
3. Trigynia, 4
4. Pentagynia, 102
5. Polygynia, 91
346

N. POLYANDRIA.
1. Monogynia, 259
2. Digynia, 11
3. Trigynia, 31
4. Tetragynia, 20
5. Pentagynia, 12
6. Polygynia, 131
564 species.

O. DIDYNAMIA.
1. Gymnospermia, 441
2. Angiospermia, 640
1081

P. TETRADYNAMIA.
1. Siliculosæ, 168
2. Siliquosæ, 258
426

Q. MONADELPHIA.
1. Triandria, 17
2. Pentandria, 134
3. Heptandria, 120
4. Octandria, 2
5. Decandria, 51
6. Endecandria, 4
7. Dodecandria, 33
8 Polyandria, 331
692

R. DIADELPHIA.
1. Pentandria, 1
2. Hexandria, 15
3. Octandria, 42
4. Decandria, 652
710

S. POLYADELPHIA.
1. Pentandria, 3
2. Dodecandria, 3
3. Icosandria, 4
4. Polyandria, 55
65

T. SYNGENESIA.
1. Polygamia Æqualis, 439
2. Pol. Superflua, 441
3. Pol. Frustranea, 116
4. Pol. Necessaria, 97
5. Pol. Segregata, 22
6. Monogamia, 88
1194

V. GYNANDRIA.
1. Diandria, 155
2. Triandria, 6
3. Tetrandria, 1
4. Pentandria, 42
5. Hexandria, 23
6. Octandria, 1
7. Decandria, 7
8. Dodecandria, 1
9. Polyandria, 50
286

U. MONOECIA.
1. Monandria, 16
2. Diandria, 8
3. Triandria, 99
4. Tetrandria, 49
5. Pentandria, 41
6. Hexandria, 4
7. Heptandria. 1
8. Polyandria, 52
9. Monadelphia, 78
10. Syngenesia,

Classification.

10. Syngenesia,	46	
11. Gynandria,	4	
		398 species.
W. Dioecia.		
1. Monandria,	1	
2. Diandria,	36	
3. Triaudria,	17	
4. Tetrandria,	21	
5. Pentandria,	19	
6. Hexandria,	33	
7. Octandria,	7	
8. Enneandria,	4	
9. Decandria,	7	
10. Dodecandria,	14	
11. Polyandria,	19	
12. Monadelphia,	26	
13. Syngenesia,	5	
14. Gynandria,	9	
		219
X. Polygamia.		
1. Monœcia,	181	
2. Dicœcia,	26	
3. Tricœcia,	16	
		213 species.
Y. Cryptogamia.		
1. Filices,	267	
2. Musci,	268	
3. Algæ,	467	
4. Fungi,	465	
		1467
Z. Palmæ,	14	
Total,		14,807 (c).

24 Minerals.

III. IN THE MINERAL KINGDOM.

Minerals are divided into four great classes, viz. Earths and Stones, Salts, Combustibles, and Metallic Ores.

Earths and Stones.		
1. Diamond genus,	1	
2. Zircon,	2	
3. Siliceous,	62	
4. Argillaceous,	29	
5. Magnesian,	17	
6. Calcareous,	22	
7. Barytic,	2	
8. Strontian,	2	
		137 species.
B. Salts.		
1. Sulphates,	6	
2. Nitrates,	1	
3. Muriates,	3	
4. Carbonates,	2	
5. Borates,	2	
6. Fluates,	1	
		15
C. Combustibles.		
1. Sulphur,	1	
2. Bituminous,	6	
3. Graphite,	2	
		9
D. Metallic Ores are divided into 24 genera, each metal forming a genus,	106	
Total,		267 species*.

Objects and utility of Natural History.

*See *Mineralogy*.

Hence, taking the whole number of known animals at 23,000, that of vegetables at 50,000 and that of minerals 267, the whole number of known species of natural objects will be 73,267.

25 Hints for studying

II. Though the classification of natural bodies is of the highest importance towards making us acquainted with unknown species, and distinguishing them from those which we already know; this alone is not sufficient to form a naturalist. His principal object should be to learn the habits, manners, and uses of the objects which he is studying; and he may perhaps be assisted in this object by the following observations.

26 Zoology.

1. In *Zoology*, or the natural history of the animal kingdom, it is necessary to ascertain both the distinctive characters of each individual animal, and its peculiar habits, properties and uses.

The naturalist first learns that the sheep, for instance, is in the class mammalia, being one of those animals that suckle their young; in the order pecora, because it is hoofed, and has no cutting teeth in the upper jaw; and that it is distinguished from other animals of the same order, by its having several blunt wedge-like incisive fore-teeth in the lower jaw only, hollow reclined horns, and no tusks.

This information would satisfy many, who call themselves naturalists; but it is far from being all that is required; the philosophical investigator of Nature inquires into its habits; as its food, its period of gestation, its season of lambing, the weather and climate most suited to its health and vigour. He endeavours to learn what produces the difference in its fleece, whether climate, food, or some peculiarity in the breed; and is anxious to ascertain what variety is most disposed to fatten, and what food effects this speedily; with many other very useful particulars.

The information of the first kind is of consequence, and even necessary in many cases; but that of the latter is most useful.

If a traveller discovers an animal possessing any useful property, or producing any useful drug, if he have not the first kind of information, he gives so confused and inaccurate a description of it, that others, mistaking the animal, discredit the author's account, and the world loses the benefit of his discovery.

27 Botany: and

2. *Botany*, or the natural history of the vegetable kingdom, in the usual acceptation of the term, implies only

(c) This number, drawn from the article Botany, compared with the three first volumes of Wildenow's edition of the *Species Plantarum*, and with Persoon's edition of the *Systema Vegetabilium*, of Linné, is certainly very far below the truth. Many years ago, the number of known species was reckoned at above twenty thousand, and there is reason to believe that it exceeds fifty thousand.

Objects and utility of Natural History.

only the knowledge of the distinctive characters of plants; and he who knows the greatest number, and is most accurate in determining the different species, is accounted the best botanist.

This however constitutes but a small part of the science; there is another distinct department, which may properly be termed the philosophy of botany, which is both more interesting and more useful. This includes the knowledge of the structure, or the anatomy of plants; and the knowledge of the uses, or functions of their various parts, as of the leaves, the bark, the pith, the roots, the juices, &c.; which is called the physiology of plants. It includes also an acquaintance with the soil and climate adapted to different vegetables, their mode of propagation, and the various uses to which their several parts or productions may be applied.

Botany, in the first sense, which may be called practical botany, is subservient, and absolutely necessary to the study of the philosophy of botany; for no one that is unacquainted with the classification of plants can either convey to others his own information, or himself receive the benefit of that of others, respecting either the structure and economy or the habits and the uses of such plants, as may have been investigated.

If medical virtues are discovered in any vegetable production; without the accuracy of the practical botanist, to ascertain and describe the particular plant which affords it, the discovery is often lost; or perhaps, what is worse, the virtues are attributed to a different plant, and it is only by repeated failures, and in some cases after much mischief, that the error is detected.

It is evident that the same may happen to the agriculturist, the dyer, or any other artizan, who has discovered in the vegetable kingdom the means of improving his art, but has not botanical knowledge sufficient to give an accurate character of the plant, to which he is indebted for his discovery.

28 Mineralogy.

3. In *Mineralogy*, or the natural history of the mineral kingdom, almost half the students are of that class, who content themselves with collecting, and being able to arrange systematically the minerals they meet with. But in this department of natural history, as well as the other two, which we have considered, something more than arrangement is required.

It is the man who can analyze, and separate the component parts of mineral productions; who knows the art of assaying, and who knows *à priori* the probable site of a quarry, or a mine, and can tell the direction of a stratum of coal, or of marble, that we may call a mineralogist.

The natural history of the mineral kingdom includes geology, or the data upon which are founded the different theories of the formation of the earth. It includes the knowledge of those facts, upon which the art of mining, and the art of separating and purifying metals, is founded; and its object is to teach likewise the properties of those metals, as well as of the earths, and other mineral productions, when separated and in their simple state.

29 Utility of the study.

With respect to *the utility of the study of natural history*, we have unavoidably given many instances of it, in considering the object of the science. We need therefore add but few others.

Objects and utility of Natural History.

The grazier knows the advantage of attending to the habits and distinctive marks of our domestic animals. It is natural history, though not often studied scientifically, that teaches him what variety of sheep to prefer; by what means to obtain a variety of cows, remarkable for their quantity of milk; how to choose the stock that is best adapted to his land, and what is the best food for them during winter.

30 To the grazier.

Much benefit is likely to accrue from the attention lately paid to the cultivation of what are termed the artificial grasses. Instead of sowing his hay seeds indiscriminately, the grazier may select only such grasses as are, by observation, found to be most suited to his soil and cattle.

31 To the farmer.

The farmer's knowledge of the proper succession of crops, the best times for sowing them, when to weed, and with what to manure, as well as how to destroy both weeds and insects, is the knowledge of a naturalist; and surely he who is scientifically acquainted with the growth of plants, knowing what part the soil acts in vegetation, and what is the aliment most required by them, will have great advantage over the mere empirical farmer, who has no better reason for what he does, than that his father did the same before him.

By studying the natural history of insects, we learn the habits of such as are noxious and injurious, and thence derive the means of destroying them.

32 To the landed proprietor.

The mineralogist has often enriched individual proprietors of land, and benefited his country, by the discovery of mines; he is enabled to direct the planners of canals by warning them of obstacles; and his knowledge has aided the physician in ascertaining the virtues of minerals, and of mineral waters.

33 In the arts.

In the arts, a knowledge of natural history prevents that confusion, and those innumerable errors that must be committed, when the natural productions which are employed cannot be accurately discriminated from others.

It is to the naturalist that we are many times indebted for the introduction of foreign animals and foreign plants into our own country. Wheat, oats, barley, and other vegetables, which are now become necessary to our existence, were not originally of British growth. The potato, now so general and so useful, was first introduced into this country by Gerard, a noted botanist, and was for some time cultivated in his garden as a rarity. The sugar-cane, the bread-fruit tree, the farinaceous palms, the flax and hemp, have all been transported by naturalists of the present day, to regions where they never grew before.

Besides the above, and many similar instances of advantage to be derived from studying the different branches of natural history, these two incalculable benefits necessarily arise to the student himself, from attending to the whole, or any part of the science; namely, a power of abstracting the mind, and reasoning methodically; and a habit of contemplating the Creator in his works *.

* *Skrimshire's Essays.*

Our limits do not permit us to enter further into the fertile topic of the utility and advantages of natural history. Its utility, in a moral and religious point of view, has been ably illustrated by Mr Ray, in his "Wisdom of God;" by Mr Bingley, in the introduction

Mode of preserving specimens.

tion to his "Animal Biography;" and, in particular, by Dr Paley, in his "Natural Theology;" and to these works we must refer our readers.

34 Art of preserving specimens.

III. We have stated it to be one of the principal objects of natural history, to teach the mode of preserving specimens. This art, called by the French *Taxidermie*, is exceedingly curious, and would well deserve a much fuller consideration than we can here allot to it. We shall confine our attention on this subject entirely to the animal kingdom, and even here we must be very brief.

The art of preparing and mounting the skins of animals appears to be pretty old; but it made no great progress before the 17th century, when Reaumur made some attempts to preserve the specimens from the attacks of insects. In the *Journal de Physique* for 1773, there is a memoir addressed to the Royal Society of London, by M. Kuckhan, on the methods of preparing birds, which is very curious, but is liable to many objections. In the same volume is a memoir by Mauduit, principally respecting the means of preserving animal specimens from the attacks of insects. His preservatives are of a poisonous nature; and, of course, their use is dangerous, while they do not appear to have been attended with the expected success. The arsenical soap of Becœur, much celebrated about the same time, is liable to similar objections.

The latest, and probably the best work on this subject, is that published a few years ago by M. Nicolas; and from this the following observations are derived.

35 Instruments employed.

The instruments employed in the preparation of specimens are much the same as those used by anatomists in their ordinary dissections, consisting of small knives or scalpels, forceps or pincers of various forms, probes, needles, and pins or wires.

36 Preservatives against insects.

The preservatives employed by M. Nicolas to protect the specimens from insects, are principally of two kinds: 1. Sulphur, which he applies to the skins by means of fumigation, thus impregnating them with sulphurous acid; 2. A liquor for macerating the skins, another liquor for rubbing over the hair, and a pomatum for anointing the inside of the skin. The *first liquor* is prepared by steeping a pound and a half of powdered oak bark, and four ounces of powdered alum, in twenty English pints of cold water, for two days, taking care to shake the mixture from time to time. The *pomatum* is prepared of a pound of white soap, half a pound of caustic potash, four ounces of powdered alum, two English pints of water, four ounces of oil of petroleum, and the same of camphire. The soap, cut into small pieces, is put into an earthen pipkin, over a moderate fire; the water poured over it; and when the whole is formed into a sort of soft paste, the alum and then the oil are added; the whole well stirred together, removed from the fire, and when it is nearly cold the camphire is added; being before hand rubbed down in a mortar with a little spirit of wine. The pomatum, thus prepared, must be kept in glass vessels, well stopt; and, when used, is to be lowered with water to the consistence of thin cream, and laid on the skins by means of a pencil brush.

The liquor employed for preserving the fur is prepared by infusing an ounce of white soap shred very small, two ounces of camphire broken into very small pieces, the same of *colocynth* or bitter-apple grossly powdered, in two English pints of spirit of wine, for four or five days, shaking the vessel from time to time, after which the liquor is to be filtered through blotting-paper.

Mode of preserving specimens.

M. Nicolas has given directions for preparing and preserving specimens of all the various classes of animals. We shall, as far as our limits permit, briefly follow him through each.

37 Directions for stuffing quadrupeds.

In skinning quadrupeds, he proposes to make an incision along the middle of the back, from the haunches to the shoulders, except in those animals whose skin is very thick and hard, or is set with spines, in which the opening must be made at the belly in the usual manner. In detaching the skin from the flesh, we must occasionally employ the knife, and as we proceed, must insert tow between the skin and flesh, to prevent soiling the fur. When the whole body is detached, and the skin drawn down as far as the ankles, the nose, and the tip of the tail, the whole body is to be cut away except the head and extremities, which are left to give a better form and support to the specimen. All the fleshy and fatty parts, the brain, and the eyes, however, must be cut away, and nothing left but the bones, the spaces between which and the skin must be stuffed with tow cut fine, and a little soft clay must be put within the orbits, in order to fix the artificial eyes.

Before stuffing, the skin is to be steeped for several days, from five to fifteen, according to the size of the animal, in the liquor first described, and after steeping, the inside is to be well anointed with the pomatum.

When the legs and head are stuffed, the cavity of the skull filled with very dry moss, and the eyes fixed, wires are to be passed through the inside of the body, the extremities, and the head and tail, in the following manner. Three iron wires of a moderate size, well annealed, at least twice as long as the animal, are to be twisted together for nearly half the length, and while one wire is left straight, the other two are to be bent at each end, so as to form a cross. When the skin is turned, ready for stuffing, these wires are to be placed within it in such a manner as that the straight wire shall pass through the head and tail, and the crossing wires through the extremities, coming out at the ball of each foot; and in this way after the cavity is filled up with tow, and the open part neatly stitched, the specimen may be fixed on a board in its natural position. Nothing remains now but to impregnate the fur with the bitter liquor last described, which is done by means of a sponge, with which the whole outside is to be well washed, then covered with folds of linen, and dried in the shade.

38 Directions for stuffing birds.

The art of preserving birds is perhaps the most curious part of the present subject, and is that to which the most attention has been given. M. Nicolas has explained at some length the mode recommended by M. Kuckhan in the *Journal de Physique;* that by Dr Lettsom, in the *Naturalist's and Traveller's Companion;* that of Mauduit, inserted in the fifth number of the *Encyclopédie Methodique;* and that of Dufresne, adopted by M. Dandin, and inserted in his *Traité d'Ornithologie;* after which he details his own.

He describes three methods of preparing birds, according as we can procure fresh-killed specimens, whole dried skins brought from abroad, or detached parts of

several

Mode of preserving specimens.

several individuals of the same species. We shall here confine ourselves to the first of these, as being best adapted to the generality of our readers.

When a fresh-killed bird is procured, it is to be placed upon a table, upon its back, with the tail turned towards the operator, who, after having separated with his fingers the feathers which cover the belly towards the right and left, is to make with a scalpel, a longitudinal incision through the skin, from the point of the breast-bone to about the middle of the belly. The edges of the skin are now to be raised with a pair of flat pincers, on each side, carefully separating the flesh as occasion may require, by the knife, and inserting a little cotton from time to time, to prevent soiling the feathers. In this way the skin is to be detached from the shoulders and neck, and as much as possible of the body laid bare, after which a pretty strong thread is to be passed through the nostrils, and tied under the lower mandible, leaving the ends of the thread when tied together, at least twice as long as the neck. Now, holding the bird by the thread, with the back turned towards him, the operator is to hold together the feathers on the two edges of the incision as well as those that cover the breast, and pushing the head of the bird inwards with his thumb so as to form the neck into an arch, is to cut this off near the body, detach from it the gullet and wind-pipe, and all the fleshy parts, both of the neck and head, by drawing the skin as far back as possible towards the beak, and cutting off the neck-bones close to the head; he is to empty the skull with a little iron instrument in the form of an ear-picker, and clean it properly with cotton. He is now to wrap cotton or tow about the head and neck, and to separate the rest of the skin, leaving the pinions and bones of the wings, and legs, and the tail, as directed for quadrupeds. After this has been done, the skin is to be turned out like a glove, with all its feathers turned inwards, all the natural openings of the bird, as well as any shot-holes, &c. made in killing the bird, are to be stitched up with a needle and fine thread; then the whole skin as well as the bones, are to be washed with a strong infusion of tan with a little alum, by means of a pencil-brush, and the skin inclosed in a covered vessel that it may not dry too hastily.

In ten or twelve hours time we may wash the skin and bones again with the astringent liquor. Twice washing in this manner will be sufficient for very small birds, but those of a middling size will require maceration in the first liquor employed for quadrupeds during two days, and four or five days for those of larger size.

The skins being well impregnated with the astringent liquor, are to be smeared with the soapy pomatum, have artificial eyes fixed in the orbits by means of wax, and stuffed and mounted much in the same manner as quadrupeds, except that the wires employed for this purpose are rather differently bended.

Great nicety is required in fixing the different parts of a bird in its natural position, and in arranging the feathers smoothly and evenly. M. Nicolas directs thin plates of lead, to be placed so as to secure the wings in the proper position till the whole is completely arranged.

To preserve the feet and legs of birds, he anoints them with linseed oil mixed with camphire, and applied a little warm.

Mode of preserving specimens.

The last operation consists in enveloping the bird with bandages of muslin or fine linen, pinned round the neck, breast, body, and rump, as well to secure the feathers in their places during drying, as to allow of their being drenched with the bitter liquor to preserve them from the attacks of insects.

39 Insects.

The different orders of insects require different modes of preparation. The following is a summary of our author's mode of preserving each kind.

For the coleoptera and hemiptera.—One of these insects, as soon as caught, is to be carefully wrapt in very fine paper, with the ends of the paper curled round to prevent the animal from moving; and this roll of paper including the insect, is to be put into a little box of pasteboard till the insect-hunter returns home. Each insect is then to be held between the thumb and fore-finger of the left hand, the wings to be raised by means of a pin, and held open with the middle finger, while the abdomen of the animal is slit open from the back, and the entrails abstracted by means of an iron wire, and the cavity as well as the edges of the wound are to be washed with the bitter spirituous liquor described in N° 36. by means of a very fine pencil. Then a small cotton plug impregnated with oil of petroleum is to be stuffed into the cavity, with the point of a wire, till the cavity is sufficiently full, when the wings are to be suffered to return to their natural situation, and the insect is ready for mounting. For mounting these insects, M. Nicolas employs little squares of card, through the middle and across which he passes a small iron wire well annealed, and about the size of a harpsicord string. A very fine needle is now to be passed through the animal, as near as possible to the corselet; and after having covered the upright iron wire with a light coating of gum-water, he passes it through the hole made by the needle, and fixes the animal in such a manner that its feet may rest upon the card.

For the lepidoptera.—He recommends them to be put, when caught, into a triangular piece of paper, and afterwards into a pasteboard box of the same form, opening with a hinge. For mounting these insects it is sufficient to perforate their bodies with a fine needle, armed with a double thread impregnated with the bitter spirituous liquor, making the needle enter by the head and come out at the end of the belly, and then cutting the thread with scissars. The insect thus prepared is mounted by means of a card, as directed for the *coleoptera*, and a piece of wood about an inch long, seven or eight lines broad, and a proper thickness, is placed below the wings on each side very near the body, and the wings are kept down by means of plates of lead.

40 Fishes.

In the preparation of specimens of fishes, M. Nicolas prefers the method of Mauduit to that given by Dr Lettsom in the *Naturalist's and Traveller's Companion;* but as Mauduit's method requires much skill and address, he recommends the following, especially for the flat kinds of fish.

He makes a longitudinal incision with scissars along the belly of the fish from the anus to the lower mandible, and then gradually and carefully separates the skin from the flesh with the assistance of the blade and flat handle of a scalpel, till he has laid bare one side of the animal. He then passes to the other side, proceeding in the same manner to detach the skin from that part, after which he separates the head from the body with a

pair

Mode of preserving specimens.

pair of scissars, and clears away the fleshy parts attached to the head. He now detaches the skin from the back as far as the anus, and then laying the fish on the table, he passes the flat handle of the scalpel below the skin that covers the tail and neighbouring parts, in order to separate it completely. This done, he pushes the tail inwards, and with the assistance of the scalpel and drawing the skin very gently, he detaches this as near as possible to the end of the tail, which he then separates with scissars, thus leaving the skin with nothing attached to it but the head and extremity of the tail. It only remains now to clear away the ears and eyes, and properly clean the head.

The skin is now steeped for some days in the tanning liquor, then laid on a table, and when the head is properly arranged, a model of the body of the fish made of soft clay, mixed with fine sand, is placed within the skin, which is made to fit neatly over it, is then bound with little bandages of linen, and suffered to dry. When the clay is quite dry and hard, and the skin has acquired so much firmness as to retain its proper form, it is to be gently beaten all over to break the clay, so that it may be withdrawn through the opening. When this is done, the whole inside of the skin and head is to be smeared by means of a pencil brush with the soap pomatum. After which it is to be entirely filled with cut tow, and the opening stitched up as neatly as possible. Then artificial eyes are to be placed in the orbits by means of soft wax, and the whole body is to be covered with a coat of white varnish prepared by digesting four ounces of clear turpentine, three ounces of sandarac, and one ounce of mastich in tears, with eight ounces of oil of turpentine, and four ounces of spirit of wine, in a bottle placed in a water bath.

41 Reptiles.

In preparing specimens of reptiles,—after what has been said above, little direction will be required. The skin is to be stript backwards as far as the head, which is to be cut off and cleaned as in other specimens; after which the skin is to be macerated, anointed within with pomatum, stuffed and varnished as before.

42 Crustacea.

The *crustacea*, including crabs, lobsters, star-fish, and sea-urchins, require but little preparation. In crabs the shell, and in lobsters the tail, is to be separated from the rest of the body; as much as possible of the meat is to be picked out from the body and large claws; the whole interior is to be smeared with the soap pomatum, and after having united the parts, the whole is to be suffered to dry.

The star-fish and urchins, if taken alive, should be killed by plunging them in spirit of wine, and afterwards drying them in the sun or in an oven moderately heated.

43 Worms.

As to *worms* the only mode of preserving the *mollusca*, or those with naked bodies, is to keep them in spirits; and of the *testacea* or shell-fish, the only part thought worth preserving is the shell; for the preparation of which, see CONCHOLOGY.

The above is but an imperfect abstract of M. Nicolas's "*Methode de preparer et conserver les Animaux de toutes les classes*," which is illustrated by plates, and is well deserving the attention of collectors of specimens.

There is also an excellent essay on this subject by Dufresne, under *Taxidermie*, in the *Nouveau Dictionaire d'Histoire Naturelle*.

History.

It will be expected that in this introductory article on natural history, we should say something of its rise and progress. Much of our observations on this subject have been anticipated in preceding articles on the particular branches of natural history, so that little remains for us to do in this place than to give a general sketch of the early history of this branch of physics.

44 History of natural history.

45 Jewish writers.

We have reason to believe that the works of nature have formed the favourite study among the ingenious and inquisitive from the earliest ages of the world. From the continual allusions to the Creator's works, and the beautiful metaphors drawn from them, which abound in the inspired writings of the Jewish prophets and poets, especially those of Job, Isaiah, Daniel and David, we know that these sages were well acquainted with natural history, as far at least as observation extended. Solomon, as we are told, was acquainted with all vegetables, "from the cedar of Lebanon to the hyssop that springeth out of the wall;" and probably so wise a man was well acquainted with the other kingdoms of nature. Some writers have gone so far as to assert that Aristotle and Theophrastus learned natural history from the writings of Solomon, though on what data they ground this assertion, we are at a loss to determine.

The principal writers on natural history among the ancients, whose writings have come down to us, are Aristotle, Theophrastus, and Pliny the elder. Of the first we may remark with Haller, that his writings on this subject exhibit a continued chain of physical and anatomical facts, which for the most part appear to have been the result of accurate observation. He relied less than any of the ancient naturalists on uncertain and fabulous report; he industriously collected and examined natural bodies, and appears to have himself dissected many animals, especially fishes, or at least to have been present at their dissection. There are even to be found in his writings, references by letters to figures which he employed to illustrate his observations.

46 Aristotle.

47 Theophrastus.

Theophrastus wrote chiefly on the natural history of plants and fossils, on winds, and on fire. His works have been edited by Heinsius, but, except in plants, they do not contain much that is worthy of our observation more than what is to be found in the writings of Aristotle.

48 Pliny.

The natural history of Pliny is a valuable repository of ancient knowledge, which, notwithstanding all its errors and extravagances, we may venture to call after the panegyric of his nephew, a comprehensive and learned work, little less various than nature herself. The author, in the dedication of his work to Vespasian, sensible of the defects with which it abounds, apologises for them, from the consideration that the path which he took had been in a great measure untrodden, and held forth to the traveller few enticements; while some parts of his subject had been so often handled, that readers were become cloyed with them: that it was an arduous task to give what is old an appearance of novelty; to add weight and authority to what is new; to cast a lustre upon subjects that have been obscured by time; to render acceptable what is become trite and disgusting; to obtain credit to doubtful relations; and, in a word, to represent every thing according to nature, and with all its natural properties. His design must be acknowledged to be grand and noble, and when we consider that the work was composed in the midst of important engagements,

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engagements, and chiefly at broken periods stolen from sleep, we shall not wonder that it was imperfectly executed.

49 Ancients deficient in method.

The ancients had no idea of methodical or systematic distinctions. As they were acquainted with but few bodies in comparison with the moderns, and attended only to those which were useful to man; they distinguished them only by their usual properties, their native country, their habitations, and the useful purposes to which they might be applied. From the few productions which they described, they were not led to perceive the necessity of searching among them for distinctive marks or relations, which may prevent their being confounded with each other. They doubtless believed that their descriptions were sufficient, and that the names which they imposed would descend with their customs to posterity, without being affected by the disorders and alterations that have changed the face of countries and the seat of empires. But the revolutions that have desolated the fairest regions of the globe, by insulating or displacing their inhabitants, or by confounding them with one another, and altering their language, have frequently almost extinguished the lamp of science. After many ages of ignorance and barbarity, we find in the few works of the ancient naturalists, which have escaped the ravages of war and the devastations of civil discord, little more than uncertainty and obscurity, with respect to those species which they have described. Notwithstanding the labours of numerous commentators, we do not certainly know what species of plant is the *cicuta* employed by the Greeks for the execution of criminals, and which terminated the life of Socrates. We cannot be sure that the animals, which we find best characterized in the ancient writings, bore the names which we attribute to them; nor are we more certain with respect to the ancient nomenclature of minerals.

50 Rise of methods.

As long as studious men cultivated the sciences only through the medium of the writings of the ancients, and attempted nothing beyond the interpretation of these, *natural history*, like every other branch of physics, remained obscure and confused, and fiction or imagination took the place of facts; but when they perceived the advantage of studying nature herself, and interrogating her by observation, methods were erected, and distinctive characters for the species introduced. This fortunate revolution took place in the 16th century. Cæsalpinus first attempted to reduce vegetables to classes, and distinguish them into tribes according to their form.—Gesner, besides the fine hints that he first gave of the constant relation between the structure of the seed and that of the other parts of plants, was the first who attempted any systematic and methodical arrangement of animals. In the 17th century, Morison, Ray, and Rivinus, improved on the hints of Cæsalpinus respecting the classification of vegetables; and Aldrovandus, Rhedi, and Swammerdam upon those of Gesner respecting animals; and in a short time this first impulse given to the art of arranging and distinguishing natural bodies by constant characters, was communicated to all those who were employed in the study of nature. Tournefort, profiting by all the attempts towards method and system in the classification of vegetables that had been made before him, advanced a considerable step in botany, by his beautiful method of distinguishing plants according to the form of their flowers and fruits, which he published towards the end of the 17th century.

History.

51 Linné and Buffon.

The same year of the 18th century (1707) gave birth to two men who have advanced the science of natural history far beyond any of their predecessors. We need scarcely mention the names of Linné and Buffon. The Swedish naturalist extended his enlarged views through every branch of natural history; he arranged in his *Systema Naturæ* and *Systema Vegetabilium* all the productions of nature, and distinguished them by characters that were precise and simple; he created a new language for expressing with brevity all these characters, and thus presented to the view, as in a compendious picture, all the properties of bodies. Buffon, proceeding in a different road, treated more copiously the most important parts of natural history, and of the animals that are most nearly allied to man, in a work which the fire of his genius and the brilliancy of his style have rendered a universal favourite. The rival of Aristotle and Pliny, whose genius he seems to have combined in the greatness of his views and extent of his plan, and altogether one of the first writers of his age, he inspired a passion for the study of nature in numbers, who without his works would never have engaged in such a study, and communicated to his countrymen that taste which has ever since survived him.

After what has been given in the particular treatises on natural history in this Encyclopædia, both as to the progress of the science, and the principal works on each department of it, since the time of Linné and Buffon; it is unnecessary for us to trace its progress beyond that period. The advances made within these few years are immense, our stock of information is prodigiously increased, and the modes of study greatly improved and facilitated. The labours of Cuvier, Geoffroy, Lacépède, Dumont, Dumeril, Lamarck, Duvernois, Sonnini, Bloch, Spallanzani, Esper, Jussieu, Wildenow, Werner, Patrin, St Fond, Brochant, Brongniart, Klaproth, Fourcroy, Vauquelin, Shaw, Latham, Bancroft, Catesby, Ellis, Smith, Withering, Woodville, Kirwan, Playfair, Thomson, Jameson, &c. with the assistance to be derived from the *Annales de Museum National*, the *Naturalist's Miscellany*, the *Linnæan Transactions*, and the splendid plates of Merian, Schreber, Curtis, Sowerby, Sotheby, &c. afford ample proofs of the industry and success with which this delightful field has been cultivated, and of the rich harvest that has been derived from the united efforts of so many men of genius and talents.

Natural Philosophy.

Natural Philosophy, is commonly defined to be that branch of knowledge which considers the powers and properties of natural bodies, and their mutual actions on one another. The province of moral philosophy is the mind of man; its inquiries and researches are into the intellectual world. Natural philosophy, on the other hand, is only concerned with the material part of the creation. The Moralist's business is to inquire into the nature of virtue, the causes and effects of vice; to propose remedies for it, and to point out the mode of attaining happiness, which only can be the result of virtuous conduct. The Naturalist, on the contrary, has nothing to do with spirit; his business is solely about body or matter; and he ought to have a solid and accurate knowledge of all material substances, together with their affections and properties; and if possible, he is to investigate the reasons of such and such appearances.—Indeed, the first and principal part of this science is, to collect all the manifest and sensible appearances of things, and reduce them into a body of natural history. Philosophy has often been said, and is even now very generally thought, to mean an inquiry into all the causes of things; but experience informs us, that though we are acquainted with a good number of effects, we can trace but few of their causes; so that philosophy itself will really be found to be in general but a collection of facts. Still, however, it differs from natural history in its appropriated sense; the business of which is only to observe the appearances of natural bodies separately, and from these appearances to class them with other bodies: natural philosophy goes farther, and recites the action of two or more bodies of the same or different kinds upon one another; and though it can neither investigate nor point out the causes of those effects, whatever they are, yet, from mathematical reasoning combined with experience, it can be demonstrated, that in such circumstances such effects must always take place. There are evidently two ways of making observations on the material world: the first is, when we view things nearly as they happen to occur, without any design or intervention of our own; in which way, indeed, no great improvements can be expected in the art, because chance having the direction, only exhibits occasional or extemporary properties. The other method is, when, after a thorough acquaintance with bodies, we apply them to other bodies equally known, diligently attending to the result, and observing whether any thing new arises. Such seems to be in general the nature of our article; nor is it our intention to be much more particular at present. We must therefore refer our readers respectively to those parts of the subject, respecting which they wish for more satisfaction and minuter details. The ancient and modern definitions of the word *philosophy*, together with its origin, as well as the manner of philosophizing in former times as well as at present, with the gradual improvement of science, particularly natural, we shall introduce, we think, more properly, under the words Philosophy and Physics. We need only add, under the present article, what however is well known, that natural philosophy was till lately divided only into four parts, commonly called the *four branches*, viz. 1. Mechanics; 2. Hydrostatics; 3. Optics; and, 4. Astronomy; and these are again subdivided into various parts. Modern discoveries have added, however, two more parts to the number, viz. Magnetism and Electricity. It is remarkable, that in the English universities these two latter branches are never taken notice of in lecturing on natural philosophy, the old division being still retained, without any mention of these two important articles. The reason may be, that they are only subject to experiment, and not yet reduced to mathematical reasoning; which is the method of teaching philosophy in one of those celebrated seminaries. Of these branches of this extensive science, it is not our intention to take even a general view in this place. We must therefore refer our readers to each particular article, where they will find them treated at considerable length.

Natural Philosophy || Nature.

NATURALISATION, in *Law*, the act of naturalizing an alien, or putting him into the condition of a natural-born subject, and entitling him to the rights and privileges thereof. But none can be naturalized unless they have received the sacrament within one month before the bringing in of the bill, and taken the oaths of allegiance and supremacy in the presence of the parliament. A person who is naturalized may have lands by descent, as heir at law, as well as obtain them by purchase; but he is disabled from being a member of the privy council or parliament; or from holding offices, 7 Jac. I. cap. 2. 12 Will. III. cap. 2. All children born out of the king's dominions, whose fathers were or are subjects of this kingdom at the time of their birth, are adjudged to be natural born subjects of this realm, except children of parents attainted of treason, or that are in the actual service of a foreign prince at enmity with us, 4 Geo. II. cap. 21. Every foreign seaman, who in time of war serves two years on board an English ship, is *ipso facto* naturalized, 13 Geo. II. cap. 3. And all foreign Protestants and Jews, upon their residing seven years in any of the British colonies, without being absent above two months at a time, or serving two years in a military capacity there, are upon taking the oaths naturalized to all intents and purposes, as if they had been born in this kingdom; and therefore are admissible to all such privileges, and no other, as Protestants or Jews born in this kingdom are entitled to. See Alien and Denizen.

In France before the Revolution, naturalization was the king's prerogative; in England it is only done by act of parliament. In the former of those places, before their government was overturned, Swiss, Savoyards, and Scots, did not require naturalization, being reputed regnicoles, or natives.

NATURALS, among physicians, whatever naturally belongs to an animal, in opposition to non-naturals. See Non-naturals.

NATURE, according to Mr Boyle, has eight different significations; it being used, 1. For the author of nature, whom the schoolmen call *Natura Naturans*, being the same with God. 2. By the nature of a thing we sometimes mean its essence; that is, the attributes which make it what it is, whether the thing be corporeal or not; as when we attempt to define the nature of a fluid, of a triangle, &c. 3. Sometimes we confound that which a man has by nature with what accrues to him by birth; as when we say, that such a man is noble by nature. 4. Sometimes we take nature for an internal principle of motion; as when we say, that

Nature || Naval.

a stone by nature falls to the earth. 5. Sometimes we understand by nature, the established course of things. 6. Sometimes we take nature for an aggregate of powers belonging to a body, especially a living one; in which sense physicians say, that nature is strong, weak, or spent; or that, in such or such diseases, nature left to herself will perform the cure. 7. Sometimes we use the term nature for the universe, or whole system of the corporeal works of God; as when it is said of a phœnix, or chimera, that there is no such thing in nature. 8. Sometimes too, and that most commonly, we express by the word *nature*, a kind of semi-deity, or other strange kind of being.

If, says the same philosopher, I were to propose a notion of nature, less ambiguous than these already mentioned, and with regard to which many axioms relating to that word may be conveniently understood, I should first distinguish between the universal and the particular nature of things. Universal nature I would define to be the aggregate of the bodies that make up the world in its present state, considered as a principle, by virtue whereof they act and suffer, according to the laws of motion prescribed by the Author of all things. And this makes way for the other subordinate notion; since the particular nature of an individual consists in the general nature applied to a distinct portion of the universe; or, which is the same thing, it is a particular assemblage of the mechanical properties of matter, as figure, motion, &c.

Kingdoms of NATURE. See KINGDOMS.

Conduct or Operations of NATURE. See *NATURAL History.*

NAVA, in *Ancient Geography*, (Tacitus); a river of Belgica, which runs north-east into the left or west side of the Rhine. Now the *Nahe*, rising at the village Naheweiler, on the borders of the bishopric of Triers, running through the Lower Palatinate, the duchy of Simmeren, by the small town of Bing, into the Rhine.

NAVAL, something relating to a ship; whence,

NAVAL Architecture. See *SHIP-Building.*

NAVAL Camp, in antiquity, a fortification, consisting of a ditch and parapet on the land side, or a wall built in the form of a semicircle, and extended from one point of the sea to another. This was sometimes defended with towers, and beautified with gates, through which they issued forth to attack their enemies. Homer hath left us a remarkable description of the Grecian fortifications of this sort, in the Trojan war, beginning at ver. 436. Iliad η.

Then, to secure the naval camp and powers,
They rais'd embattled walls with lofty towers:
From space to space were ample gates around,
For passing chariots; and a trench profound,
Of large extent; and deep in earth below
Strong piles infix'd stood adverse to the foe.
POPE'S *Transl.*

Towards the sea, or within it, they fixed great pales of wood, like those in their artificial harbours: before these the vessels of burden were placed in such order as that they might be instead of a wall, and give protection to those within; in which manner Nicias is reported by Thucydides to have encamped himself: but this seems only to have been practised when the enemy was thought superior in strength, and raised great apprehensions of danger in them. When their fortifications were thought strong enough to defend them from the assaults of enemies, it was frequent to drag their ships to shore, which the Greeks called ενωλκειν, the Romans *subducere*. Around the ships the soldiers disposed their tents, as appears everywhere in Homer: but this seems only to have been practised in winter, when their enemy's fleet was laid up and could not assault them; or in long sieges, and when they lay in no danger from their enemies by sea; as in the Trojan war, where the defenders of Troy never once attempted to encounter the Grecians in a sea-fight.

Naval || Navarre.

The adjacent places were usually filled with inns and stews, well stocked with females, that prostituted themselves to the mariners, merchants, and artificers of all sorts, who flocked thither in great numbers; this, however, appears to have happened only in times of peace.

NAVAL Crown, among the ancient Romans, a crown adorned with figures of prows of ships, conferred on persons who in sea engagements first boarded the enemy's vessel. See CROWN.

NAVAL Engagement. See TACTICS, *Naval.*

NAVAL Stores, comprehend all those particulars made use of, not only in the royal navy, but in every other kind of navigation; as timber and iron for shipping, pitch, tar, hemp, cordage, sail cloth, gunpowder, ordnance, and fire arms of every sort, ship chandlery wares, &c.

NAVAL Tactics, the military operations of fleets. See TACTICS, *Naval.*

NAVAN, a borough town of Ireland, in the county of Meath and province of Leinster; situated about 23 miles north-west of Dublin, on the river Boyne. It consists of two chief streets, which intersect each other at right angles.—The tholsel, or town house, is a handsome stone building. This place was formerly in great repute, and walled in by Hugh de Lacy. An abbey for regular canons, dedicated to the Virgin Mary, was erected here; but whether antecedent to the end of the 12th century is not certain: about that period, however, it was either founded or re-edified by Joceline de Angulo or Nangle. In the burial ground are the remains of many ancient tombs. A barrack for horse is now built on the site of the abbey.

NAVARRE, a province of Spain, part of the ancient kingdom of Navarre, erected soon after the invasion of the Moors; and is otherwise called *Upper Navarre*, to distinguish it from Lower Navarre belonging to the French. It is bounded on the south and east by Arragon, on the north by the Pyrenees, and on the west by Old Castile and Biscay; extending from south to north about 80 miles, and from east to west about 75. It abounds in sheep and cattle; game of all kinds, as boars, stags, and roebucks; and in wild fowl, horses, and honey; yielding also some grain, wine, oil, and a variety of minerals, medicinal waters, and hot baths. Some of the ancient chiefs of this country were called *Sobrarbores*, from the custom, as it is supposed, which prevailed among some of those free nations, of choosing and swearing their

Navarre. their princes under some particular tree. The name of the province is supposed to be a contraction of *Nava Errea*, signifying, in the language of the Vascones, its ancients inhabitants, "a land of valleys." —For the particulars of its history, see the article SPAIN.

NAVARRE, *Peter*, an officer of eminence in the 16th century, and particularly celebrated for his dexterity in the directing and springing of mines. He was a native of Biscay, and of low extraction. According to Paul Jove, who affirms that he had an account of the matter from his own mouth, he was first a sailor; but being disgusted with that employment, he sought his fortune in Italy, when poverty compelled him to become footman to the cardinal of Arragon. He afterwards inlisted himself a soldier in the Houstine army; and having served there for some time, went to sea again, and distinguished himself by his courage. The reputation of his valour having reached the ears of Gonsalvo de Cordova, this general employed him in the war against Naples, and raised him to the rank of a captain. Having contributed greatly to the taking of that city by very opportunely springing a mine, the emperor rewarded him for this signal service with the earldom of Alveto, situated in that kingdom, and gave him the title of *Count of Navarre*. Having the command of a naval expedition against the Moors in Africa, he was at first very successful, and took possession of Oran, Tripoli, and some other places; but being afterwards shipwrecked on the island of Gerbes, the great heats and the Moorish cavalry destroyed a part of his army. Our hero was equally unfortunate in Italy: He was made prisoner at the famous battle of Ravenna in 1512, and languished in France for the space of two years. When finding that the king of Spain, who had been prejudiced against him by his courtiers, would do nothing towards his ransom, he went into the service of Francis I. who gave him the command of 20 companies of infantry, consisting of Gascons, Biscayans, and the inhabitants of the Pyrenean mountains. He distinguished himself in several successful expeditions, until the year 1522, when having been sent to the relief of the Genoese, he was taken by the Imperialists. They conducted him to Naples, where he remained a prisoner for three years in the Castel del Ovo. From this confinement he was released by the treaty of Madrid, and afterwards fought at the siege of Naples under Laulric in 1528: but being again made prisoner at the unfortunate retreat from Aversa, he was conducted a second time to the Castel del Ovo. Here the prince of Orange, having by order of the emperor, caused several persons of the *Angevine* faction to be beheaded, our hero would undoubtedly have suffered the same fate, if the governor, seeing his distressed situation, and feeling for the misfortunes of so great a man, had not saved him the shame of this last punishment by allowing him to die a natural death. Others pretend that he was strangled in his bed, having arrived at a very advanced age. Paul Jove and Philip Thomasini have written his life. This last informs us, that he was of a tall size, had a swarthy countenance, black eyes, beard, and hair. A duke of Sessa, in the last century, being desirous to honour his memory and that of the marshal de Lautree, caused a monument to be erected to each of them in the church of Saint-Marie-le Neuve at Naples, where they had been interred without any funeral honours.

Navarre || Nave.

NAVARRE, *Martin*, surnamed *Azpilcueta*, because he was born in the kingdom which bears that name, successively professor of jurisprudence at Toulouse, Salamanca, and Coimbra, was consulted from all quarters as the oracle of law. For a part of his knowledge he was indebted to the schools of Cahors and Toulouse, in which he had studied. His friend Barthelemi Carewza, a Dominican, and archbishop of Toledo, having been charged with heresy by the court of inquisition at Rome, Navarre set out at the age of 80 years to defend him. Pius V. appointed him assessor to Cardinal Francis Alciat, vice-penitentiary. Gregory XIII. never passed his gate without sending for him, and sometimes would converse with him for an hour together on the street: he even deigned to visit him, accompanied by several cardinals. These honours did not render him more haughty. His character became so eminent, that even in his own time the greatest encomium that could be paid to a man of learning was to say that he was a *Navarre:* this name thus included the idea of erudition, as that of Roscius formerly marked an accomplished comedian. Azpilcueta was the oracle of the city of Rome, and of the whole Christian world. For the influence which he had acquired, he was indebted not only to his knowledge, but also to his probity and virtue. Faithful to the duties which the church prescribed, his temperance and frugality preserved to him a vigorous constitution; and at a very advanced age his genius was equal to the severest study. His savings enabled him to give liberal assistance to the poor. His charities, indeed, were so great, that his mule, it is said, would stop as soon as she perceived a beggar. He died at Rome in 1586, at the age of 92. His works were collected and printed in 6 vols. folio at Lyons in 1597, and at Venice in 1602. They displayed more learning than judgement, and are now very seldom consulted. Navarre was uncle by the mother's side to St Francis of Sales. See SALES.

NAUCRARI, among the Athenians, was the name given to the chief magistrates of the Δημοι, "boroughs or townships," called Ναυκραριαι; because each was obliged, besides two horsemen, to furnish out one ship for the public service.

NAUCRATES, a Greek poet, who was employed by Artemisia to write a panegyric upon Mausolus.—An orator who endeavoured to alienate the cities of Lycia from the interests of Brutus.

NAUCRATIS, a city of Egypt on the left side of the Canopic mouth of the Nile. It was celebrated for its commerce, and no ship was permitted to land at any other place, but was obliged to sail directly to the city, there to deposite its cargo. It gave birth to Athenæus.

NAUCRATITES Nomos, in *Ancient Geography*, (Pliny); a division of the Delta, so called from that town *Naucratis;* though Ptolemy comprises it under the Nomos Saites.

NAUCYDES, a statuary who lived about four centuries before the Christian era.

NAVE, in *Architecture*, the body of a church, where the people are disposed, reaching from the baluster, or rail of the door, to the chief choir. Some

Nave, Navel. derive the word from the Greek ναος, "a temple;" and others from ναυς, "a ship," by reason the vault or roof of a church bears some resemblance to a ship.

NAVEL, in *Anatomy*, the centre of the lower part of the abdomen; being that part where the umbilical vessels passed out of the placenta of the mother. See ANATOMY *Index*. Navel, Navew.

Navel-Wort. See COTYLEDON, BOTANY *Index*.

NAVEW. See BRASSICA, BOTANY *Index*.

NAVIGATION

IS the art of conducting or carrying a ship from one port to another.

HISTORY.

THE poets refer the invention of the art of navigation to Neptune, some to Bacchus, others to Hercules, others to Jason, and others to Janus, who is said to have made the first ship. Historians ascribe it to the Æginetes, the Phœnicians, Tyrians, and the ancient inhabitants of Britain. Some suppose, that the first hint was taken from the flight of the kite; others, as Oppian (*De Piscibus*, lib. i.), from the fish called *nautilus:* others ascribe it to accident.—Scripture refers the origin of so useful an invention to God himself, who gave the first specimen thereof in the ark built by Noah under his direction. For the raillery which the good man underwent on account of his enterprise shows evidently enough that the world was then ignorant of any thing like navigation, and that they even thought it impossible.

However, profane history represents the Phœnicians, especially those of their capital Tyre, as the first navigators; being urged to seek a foreign commerce by the narrowness and poverty of a slip of ground they possessed along the coasts; as well as by the convenience of two or three good ports, and by their natural genius for traffic. Accordingly, Lebanon, and the other neighbouring mountains, furnishing them with excellent wood for ship-building, in a short time they were masters of a numerous fleet; and constantly hazarding new navigations, and settling new trades, they soon arrived at an incredible pitch of opulence and populousness: insomuch as to be in a condition to send out colonies, the principal of which was that of Carthage; which, keeping up their Phœnician spirit of commerce, in time not only equalled Tyre itself, but vastly surpassed it; sending its merchant fleets through Hercules's Pillars, now the straits of Gibraltar, along the western coasts of Africa and Europe; and even, if we believe some authors, to America itself.

Tyre, whose immense riches and power are represented in such lofty terms both by sacred and profane authors, being destroyed by Alexander the Great, its navigation and commerce were transferred by the conqueror to Alexandria, a new city admirably situated for those purposes; proposed for the capital of the empire of Asia, which Alexander then meditated. And thus arose the navigation of the Egyptians; which was afterwards so much cultivated by the Ptolemies, that Tyre and Carthage were quite forgotten.

Egypt being reduced into a Roman province after the battle of Actium, its trade and navigation fell into the hands of Augustus; in whose time Alexandria was only inferior to Rome; and the magazines of the capital of the world were wholly supplied with merchandises from the capital of Egypt.

At length, Alexandria itself underwent the fate of Tyre and Carthage; being surprised by the Saracens, who in spite of the emperor Heraclius, overspread the northern coasts of Africa, &c. whence the merchants being driven, Alexandria has ever since been in a languishing state, though it still has a considerable part of the commerce of the Christian merchants trading to the Levant.

The fall of Rome and its empire drew along with it not only that of learning and the polite arts, but that of navigation; the barbarians into whose hands it fell, contenting themselves with the spoils of the industry of their predecessors.

But no sooner were the more brave among those nations well settled in their new provinces, some in Gaul, as the Franks; others in Spain, as the Goths; and others in Italy, as the Lombards; but they began to learn the advantages of navigation and commerce, and the methods of managing them, from the people they subdued; and this with so much success, that in a little time some of them became able to give new lessons, and set on foot new institutions for its advantage. Thus it is to the Lombards we usually ascribe the invention and use of banks, book-keeping, exchanges, rechanges, &c.

It does not appear which of the European people, after the settlement of their new masters, first betook themselves to navigation and commerce. Some think it began with the French; though the Italians seem to have the justest title to it; and are accordingly regarded as the restorers thereof, as well as of the polite arts, which had been banished together from the time the empire was torn asunder. It is the people of Italy then, and particularly those of Venice and Genoa, who have the glory of this restoration; and it is to their advantageous situation for navigation they in great measure owe their glory. In the bottom of the Adriatic were a great number of marshy islands, only separated by narrow channels, but those well screened, and almost inaccessible, the residence of some fishermen, who here supported themselves by a little trade in fish and salt, which they found in some of these islands. Thither the Veneti, a people inhabiting that part of Italy along the coasts of the gulf, retired, when Alaric king of the Goths, and afterwards Attila king of the Huns, ravaged Italy.

These new islanders, little imagining that this was to be their fixed residence, did not think of composing any body politic; but each of the 72 islands of this little archipelago continued a long time under its several masters, and each made a distinct commonwealth. When their commerce was become considerable enough to give jealousy to their neighbours, they began to think

think of uniting into a body. And it was this union, first begun in the sixth century, but not completed till the eighth, that laid the sure foundation of the future grandeur of the state of Venice. From the time of this union, their fleets of merchantmen were sent to all the ports of the Mediterranean; and at last to those of Egypt, particularly Cairo, a new city built by the Saracen princes on the eastern banks of the Nile, where they traded for the spices and other products of the Indies. Thus they flourished, increased their commerce, their navigation, and their conquests on the terra firma, till the league of Cambray in 1508, when a number of jealous princes conspired to their ruin; which was the more easily effected by the diminution of their East India commerce, of which the Portuguese had got one part and the French another. Genoa, which had applied itself to navigation at the same time with Venice, and that with equal success, was a long time its dangerous rival, disputed with it the empire of the sea, and shared with it the trade of Egypt and other parts both of the east and west.

Jealousy soon began to break out; and the two republics coming to blows, there was almost continual war for three centuries before the superiority was ascertained; when, towards the end of the 14th century, the battle of Chioza ended the strife; the Genoese, who till then had usually the advantage, having now lost all; and the Venetians, almost become desperate, at one happy blow, beyond all expectation, secured to themselves the empire of the sea, and superiority in commerce.

About the same time that navigation was retrieved in the southern parts of Europe, a new society of merchants was formed in the north, which not only carried commerce to the greatest perfection it was capable of till the discovery of the East and West Indies, but also formed a new scheme of laws for the regulation therefore, which still obtain under the names of *Uses and Customs of the Sea.* This society is that famous league of the Hanse towns, commonly supposed to have begun about the year 1164. See *Hanse Towns.*

For the modern state of navigation in England, Holland, France, Spain, Portugal, &c. see Commerce, Company, &c.

We shall only add, that in examining the causes of commerce passing successively from the Venetians, Genoese, and Hanse towns, to the Portuguese and Spaniards, and from these again to the English and Dutch, it may be established as a maxim, that the relation between commerce and navigation, or if we may be allowed to say it, their union, is so intimate, that the fall of the one inevitably draws after it that of the other; and that they will always either flourish or dwindle together. Hence so many laws, ordinances, statutes, &c. for its regulation; and hence particularly that celebrated act of navigation, which an eminent foreign author calls the *palladium* or *tutelar deity of the commerce of England;* which is the standing rule, not only of the British among themselves, but also of other nations with whom they traffic.

The art of navigation has been exceedingly improved in modern times, both with regard to the form of the vessels themselves, and with regard to the methods of working them. The use of rowers is now entirely superseded by the improvements made in the formation of the sails, rigging, &c. by which means ships can not only sail much faster than formerly, but can tack in any direction with the greatest facility. It is also very probable that the ancients were neither so well skilled in finding the latitudes, nor in steering their vessels in places of difficult navigation, as the moderns. But the greatest advantage which the moderns have over the ancients is from the mariner's compass, by which they are enabled to find their way with as great facility in the midst of an immeasurable ocean, as the ancients could have done by creeping along the coast, and never going out of sight of land. Some people indeed contend, that this is no new invention, but that the ancients were acquainted with it. They say, that it was impossible for Solomon to have sent ships to Ophir, Tarshish, and Parvaim, which last they will have to be *Peru*, without this useful instrument. They insist, that it was impossible for the ancients to be acquainted with the attractive virtue of the magnet, and to be ignorant of its polarity. Nay, they affirm, that this property of the magnet is plainly mentioned in the book of Job, where the loadstone is mentioned by the name of *topaz*, or *the stone that turns itself.* But it is certain, that the Romans, who conquered Judea, were ignorant of this instrument; and it is very improbable, that such an useful invention, if once it had been commonly known to any nation, would have been forgot, or perfectly concealed from such a prudent people as the Romans, who were so much interested in the discovery of it.

Among those who admit that the mariner's compass is a modern invention, it has been much disputed who was the inventor. Some give the honour of it to Flavio Gioia of Amalfi in Campania *, who lived about the beginning of the 14th century; while others say that it came from the east, and was earlier known in Europe. But, at whatever time it was invented, it is certain, that the mariner's compass was not commonly used in navigation before the year 1420. In that year the science was considerably improved under the auspices of Henry duke of Visco, brother to the king of Portugal. In the year 1485, Roderick and Joseph, physicians to John II. king of Portugal, together with one Martin de Bohemia, a Portuguese, native of the island of Fayal, and scholar to Regiomontanus, calculated tables of the sun's declination for the use of sailors, and recommended the astrolabe for taking observations at sea. Of the instructions of Martin, the celebrated Christopher Columbus is said to have availed himself, and to have improved the Spaniards in the knowledge of the art; for the farther progress of which a lecture was afterwards founded at Seville by the emperor Charles V.

* See *Mariner's Compass.*

The discovery of the variation is claimed by Columbus, and by Sebastian Cabot. The former certainly did observe this variation without having heard of it from any other person, on the 14th of September 1492, and it is very probable that Cabot might do the same. At that time it was found that there was no variation at the Azores, where some geographers have thought proper to place the first meridian; though it hath since been observed that the variation alters in time.—The use of the cross staff now began to be introduced among sailors. This ancient instrument is described by John Werner of Nuremberg, in his

his annotations on the first book of Ptolemy's Geography, printed in 1514. He recommends it for observing the distance between the moon and some star, in order thence to determine the longitude.

At this time the art of navigation was very imperfect, on account of the inaccuracies of the plane chart, which was the only one then known, and which, by its gross errors, must have greatly misled the mariner, especially in voyages far distant from the equator. Its precepts were probably at first only set down on the sea charts, as is the custom at this day: but at length there were two Spanish treatises published in 1545; one by Pedro de Medina; the other by Martin Cortes, which contained a complete system of the art, as far as it was then known. These seem to have been the oldest writers who fully handled the art; for Medina, in his dedication to Philip prince of Spain, laments that multitudes of ships daily perished at sea, because there were neither teachers of the art, nor books by which it might be learned; and Cortes, in his dedication, boasts to the emperor that he was the first who had reduced navigation into a compendium, valuing himself much on what he had performed. Medina defended the plane chart; but he was opposed by Cortes, who showed its errors, and endeavoured to account for the variation of the compass, by supposing the needle to be influenced by a magnetic pole (which he called the *point attractive*), different from that of the world; which notion hath been farther prosecuted by others. Medina's book was soon translated into Italian, French, and Flemish, and served for a long time as a guide to foreign navigators. However, Cortes was the favourite author of the English nation, and was translated in 1561; while Medina's work was entirely neglected, though translated also within a short time of the other. At that time the system of navigation consisted of the following particulars, and others similar: An account of the Ptolemaic hypothesis, and the circles of the sphere; of the roundness of the earth, the longitudes, latitudes, climates, &c. and eclipses of the luminaries; a kalendar; the method of finding the prime, epact, moon's age, and tides; a description of the compass, an account of its variation, for the discovering of which Cortes said an instrument might easily be contrived; tables of the sun's declination for four years, in order to find the latitude from his meridian altitude; directions to find the same by certain stars; of the course of the sun and moon; the length of the days; of time and its divisions; the method of finding the hour of the day and night; and lastly, a description of the sea chart, on which to discover where the ship is, they made use of a small table, that showed, upon an alteration of one degree of the latitude, how many leagues were run in each rhumb, together with the departure from the meridian. Besides, some instruments were described, especially by Cortes; such as one to find the place and declination of the sun, with the days, and place of the moon; certain dials, the astrolabe, and cross staff; with a complex machine to discover the hour and latitude at once.

About the same time were made proposals for finding the longitude by observations of the moon.—In 1530, Gemma Frisius advised the keeping of the time by means of small clocks or watches, then, as he says, newly invented. He also contrived a new sort of cross staff, and an instrument called the *nautical quadrant*; which last was much praised by William Cunningham, in his *Astronomical Glass*, printed in the year 1559.

In 1537 Pedro Nunez, or Nonius, published a book in the Portuguese language, to explain a difficulty in navigation proposed to him by the commander Don Martin Alphonso de Susa. In this he exposes the errors of the plane chart, and likewise gives the solution of several curious astronomical problems; amongst which is that of determining the latitude from two observations of the sun's altitude and intermediate azimuth being given. He observed, that though the rhumbs are spiral lines, yet the direct course of a ship will always be in the arch of a great circle, whereby the angle with the meridians will continually change: all that the steersman can here do for the preserving of the original rhumb, is to correct these deviations as soon as they appear sensible. But thus the ship will in reality describe a course without the rhumb line intended; and therefore his calculations for assigning the latitude, where any rhumb line crosses the several meridians, will be in some measure erroneous. He invented a method of dividing a quadrant by means of concentric circles, which, after being much improved by Dr Halley, is used at present, and is called a *nonius*.

In 1577, Mr William Bourne published a treatise, in which, by considering the irregularities in the moon's motion, he shows the errors of the sailors in finding her age by the epact, and also in determining the hour from observing on what point of the compass the sun and moon appeared. He advises, in sailing towards the high latitudes, to keep the reckoning by the globe, as there the plane chart is most erroneous. He despairs of our ever being able to find the longitude, unless the variation of the compass should be occasioned by some such attractive point as Cortes had imagined; of which, however, he doubts: but as he had shown how to find the variation at all times, he advises to keep an account of the observations, as useful for finding the place of the ship; which advice was prosecuted at large by Simon Stevin, in a treatise published at Leyden in 1599; the substance of which was the same year printed at London in English by Mr Edward Wright, entitled the Haven-finding Art. In this ancient tract also is described the way by which our sailors estimate the rate of a ship in her course, by an instrument called the *log*. This was so named from the piece of wood or log that floats in the water while the time is reckoned during which the line that is fastened to it is veering out. The author of this contrivance is not known; neither was it taken notice of till 1607, in an East India voyage published by Purchas: but from this time it became famous, and was much taken notice of by almost all writers on navigation in every country; and it still continues to be used as at first, though many attempts have been made to improve it, and contrivances proposed to supply its place; many of which have succeeded in quiet water, but proved useless in a stormy sea.

In 1581 Michael Coignet, a native of Antwerp, published a treatise, in which he animadverted on Medina. In this he showed, that as the rhumbs are spirals,

rals; making endless revolutions about the poles, numerous errors must arise from their being represented by straight lines on the sea charts; but though he hoped to find a remedy for these errors, he was of opinion that the proposals of Nonius were scarcely practicable, and therefore in a great measure useless. In treating of the sun's declination, he took notice of the gradual decrease in the obliquity of the ecliptic; he also described the cross staff with three transverse pieces, as it is at present made, and which he owned to have been then in common use among the sailors. He likewise gave some instruments of his own invention; but all of them are now laid aside, excepting perhaps his nocturnal. He constructed a sea table to be used by such as sailed beyond the 60th degree of latitude; and at the end of the book is delivered a method of sailing on a parallel of latitude by means of a ring dial and a 24 hour glass. The same year the discovery of the dipping needle was made by Mr Robert Norman *. In his publication on that art he maintains, in opposition to Cortes, that the variation of the compass was caused by some point on the surface of the earth, and not in the heavens: he also made considerable improvements in the construction of compasses themselves; showing especially the danger of not fixing, on account of the variation, the wire directly under the *fleur de luce;* as compasses made in different countries have it placed differently. To this performance of Norman's is always prefixed a discourse on the variation of the magnetical needle, by Mr William Burrough, in which he shows how to determine the variation in many different ways. He also points out many errors in the practice of navigation at that time, and speaks in very severe terms concerning those who had published upon it.

* See *Dipping Needle.*

All this time the Spaniards continued to publish treatises on the art. In 1585 an excellent compendium was published by Roderico Zamorano; which contributed greatly towards the improvement of the art, particularly in the sea charts. Globes of an improved kind, and of a much larger size than those formerly used, were now constructed, and many improvements were made in other instruments; however, the plane chart continued still to be followed, though its errors were frequently complained of. Methods of removing these errors had indeed been sought after; and Gerard Mercator seems to have been the first who found the true method of doing this, so as to answer the purposes of seamen. His method was to represent the parallels both of latitude and longitude by parallel straight lines, but gradually to augment the former as they approached the pole. Thus the rhumbs, which otherwise ought to have been curves, were now also extended into straight lines; and thus a straight line drawn between any two places marked upon the chart would make an angle with the meridians, expressing the rhumb leading from the one to the other. But though, in 1569, Mercator published an universal map constructed in this manner, it doth not appear that he was acquainted with the principles on which this proceeded; and it is now generally believed, that the true principles on which the construction of what is called *Mercator's chart* depends, were first discovered by an Englishman, Mr Edward Wright.

Mr Wright supposes, but, according to the general opinion, without sufficient grounds, that this enlargement of the degrees of latitude was known and mentioned by Ptolemy, and that the same thing had also been spoken of by Cortes. The expressions of Ptolemy alluded to, relate indeed to the proportion between the distances of the parallels and meridians; but instead of proposing any gradual enlargement of the parallels of latitude in a general chart, he speaks only of particular maps; and advises not to confine a system of such maps to one and the same scale, but to plan them out by a different measure, as occasion might require: only with this precaution, that the degrees of longitude in each should bear some proportion to those of latitude; and this proportion is to be deduced from that which the magnitude of the respective parallels bears to a great circle of the sphere. He adds, that in particular maps, if this proportion be observed with regard to the middle parallel, the inconvenience will not be great though the meridians should be straight lines parallel to each other. Here he is said only to mean, that the maps should in some measure represent the figures of the countries for which they are drawn. In this sense Mercator, who drew maps for Ptolemy's tables, understood him; thinking it, however, an improvement not to regulate the meridians by one parallel, but by two; one distant from the northern, the other from the southern extremity of the map by a fourth part of the whole depth; by which means, in his maps, though the meridians are straight lines, yet they are generally drawn inclining to each other towards the poles. With regard to Cortes, he speaks only of the number of degrees of latitude, and not of the extent of them; nay, he gives express directions that they should all be laid down by equal measurement on a scale of leagues adapted to the map.

For some time after the appearance of Mercator's map, it was not rightly understood, and it was even thought to be entirely useless, if not detrimental.—However, about the year 1592, its utility began to be perceived; and seven years after, Mr Wright printed his famous treatise entitled, The Correction of certain Errors in Navigation, where he fully explained the reason of extending the length of the parallels of latitude, and the uses of it to navigators. In 1610, a second edition of Mr Wright's book was published with improvements. An excellent method was proposed of determining the magnitude of the earth; at the same time it was judiciously proposed to make our common measures in some proportion to a degree on its surface, that they might not depend on the uncertain length of a barley corn. Some of his other improvements were, "The table of latitudes for dividing the meridian computed to minutes;" whereas it had been only divided to every tenth minute. He also published a description of an instrument which he calls the *sea rings;* and by which the variation of the compass, altitude of the sun, and time of the day, may be determined readily at once in any place, provided the latitude is known. He showed also how to correct the errors arising from the eccentricity of the eye in observing by the cross-staff. He made a total amendment in the tables of the declinations and places of the sun and stars from his own observations made with a six foot quadrant in the years 1594, 95, 96, and 97. A sea quadrant to take altitudes by a forward or backward observation; and likewise with a contrivance for the ready finding the

latitude

latitude by the height of the pole star, when not upon the meridian. To this edition was subjoined a translation of Zamorano's Compendium above mentioned, in which he corrected some mistakes in the orginal; adding a large table of the variation of the compass observed in very different parts of the world, to show that it was not occasioned by any magnetical pole.

These improvements soon became known abroad.—In 1608, a treatise entitled, *Hypomnemata Mathematica*, was published by Simon Stevin, for the use of Prince Maurice. In that part relating to navigation, the author having treated of sailing on a great circle, and shown how to draw the rhumbs on a globe mechanically, sets down Wright's two tables of latitudes and of rhumbs, in order to describe these lines more accurately, pretending even to have discovered an error in Wright's table. But all Stevin's objections were fully answered by the author himself, who showed that they arose from the gross way of calculating made use of by the former.

In 1624, the learned Wellebrordus Snellius, professor of mathematics at Leyden, published a treatise of navigation on Wright's plan, but somewhat obscurely: and as he did not particularly mention all the discoveries of Wright, the latter was thought by some to have taken the hint of all his discoveries from Snellius. But this supposition is long ago refuted: and Wright enjoys the honour of those discoveries which is justly his due.

Mr Wright having shown how to find the place of the ship on his chart, observed that the same might be performed more accurately by calculation: but considering, as he says, that the latitudes, and especially the courses at sea, could not be determined so precisely, he forbore setting down particular examples; as the mariner may be allowed to save himself this trouble, and only mark out upon his chart the ships's way, after the manner then usually practised. However, in 1614, Mr Raphe Handson, among his nautical questions subjoined to a translation of Pitiscus's trigonometry, solved very distinctly every case of navigation, by applying arithmetical calculations to Wright's table of latitudes, or of meridional parts, as it hath since been called. Though the method discovered by Wright for finding the change of longitude by a ship sailing on a rhumb is the proper way of performing it, Handson also proposes two ways of approximation to it without the assistance of Wright's division of the meridian line. The first was computed by the arithmetical mean between the cosines of both latitudes; the other by the same mean between the secants as an alternative, when Wright's book was not at hand; though this latter is wider from the truth than the first. By the same calculations also he showed how much each of these compendiums deviates from the truth, and also how widely the computations on the erroneous principles of the plane chart differ from them all. The method, however, commonly used by our sailors is commonly called the *middle latitude;* which, though it errs more than that by the arithmetical mean between the two cosines, is preferred on account of its being less operose: yet in high latitudes it is more eligible to use that of the arithmetical mean between the logarithmic cosines, equivalent to the geometrical mean between the cosines themselves; a method since proposed by Mr John Bassat. The computation by the middle latitude will always fall short of the true change of longitude; that by the geometrical mean will always exceed; but that by the arithmetical mean falls short in latitudes above 45 degrees, and exceeds in lesser latitudes. However, none of these methods will differ much from the truth when the change of latitude is sufficiently small.

About this time logarithms were invented by John Napier, baron of Merchiston in Scotland, and proved of the utmost service to the art of navigation. From which Mr Edmund Gunter constructed a table of logarithmic sines and tangents to every minute of the quadrant, which he published in 1620. In this work he applied to navigation, and other branches of mathematics, his admirable ruler known by the name of Gunter's scale *; on which are described lines of logarithms, of logarithmic sines and tangents, of meridional parts, &c. He greatly improved the sector for the sames purposes. He showed also how to take a back observation by the cross staff, whereby the error arising from the eccentricity of the eye is avoided. He described likewise another instrument, of his own invention called the *cross bow*, for taking altitudes of the sun or stars, with some contrivances for the more ready collecting the latitude from the observation. The discoveries concerning logarithms were carried to France in 1624 by Mr Edmund Wingate, who published two small tracts in that year at Paris. In one of these he taught the use of Gunter's scale; and in the other, of the tables of artificial sines and tangents, as modelled according to Napier's last form, erroneously attributed by Wingate to Briggs.

* *See Gunter's Scale*

Gunter's rule was projected into a circular arch by the Reverend Mr William Oughtred in 1633, and its uses fully shown in a pamphlet entitled, *The Circles of Proportion*, where, in an appendix, are well treated several important points in navigation. It has also been made in the form of a sliding ruler.

The logarithmic tables were first applied to the different cases of sailing by Mr Thomas Addison, in his treatise entitled, *Arithmetical Navigation*, printed in 1625. He also gives two traverse tables, with their uses; the one to quarter points of the compass, the other to degrees. Mr Henry Gellibrand published his discovery of the changes of the variation of the compass, in a small quarto pamphlet, entitled, *A discourse mathematical on the variation of the magnetical needle*, printed in 1635. This extraordinary phenomenon he found out by comparing the observations made at different times near the same place by Mr Burrough, Mr Gunter, and himself, all persons of great skill and experience in these matters. This discovery was likewise soon known abroad; for Father Athanasius Kircher, in his treatise entitled, *Magnes*, first printed at Rome in 1641, informs us, that he had been told it by Mr John Greaves; and then gives a letter of the famous Marinus Mersennus, containing a very distinct account of the same.

As altitudes of the sun are taken on shipboard by observing his elevation above the visible horizon; to obtain from thence the sun's true altitude with correctness, Wright observes it to be necessary that the dip of the visible horizon below the horizontal plane passing through the observer's eye should be brought into the account,

account, which cannot be calculated without knowing the magnitude of the earth. Hence he was induced to propose different methods for finding this; but complains that the most effectual was out of his power to execute; and therefore contented himself with a rude attempt, in some measure sufficient for his purpose: and the dimensions of the earth deduced by him corresponded very well with the usual divisions of the log line; however, as he wrote not an express treatise on navigation, but only for the correcting such errors as prevailed in general practice, the log line did not fall under his notice. Mr Richard Norwood, however, put in execution the method recommended by Mr Wright as the most perfect for measuring the dimensions of the earth, with the true length of the degrees of a great circle upon it; and, in 1635, he actually measured the distance between London and York; from whence, and the summer solstitial altitudes of the sun observed on the meridian at both places, he found a degree on a great circle of the earth to contain 367,196 English feet, equal to 57,300 French fathoms or toises: which is very exact, as appears from many measures that have been made since that time. Of all this Mr Norwood gave a full account in his treatise called *The Seaman's Practice*, published in 1637. He there shows the reason why Snellius had failed in his attempt: he points out also various uses of his discovery, particularly for correcting the gross errors hitherto committed in the divisions of the log line. But necessary amendments have been little attended to by sailors, whose obstinacy in adhering to established errors has been complained of by the best writers on navigation. This improvement has at length, however, made its way into practice, and few navigators of reputation now make use of the old measure of 42 feet to a knot. In that treatise also Mr Norwood describes his own excellent method of setting down and perfecting a sea reckoning, by using a traverse table; which method he had followed and taught for many years. He shows also how to rectify the course by the variation of the compass being considered; as also how to discover currents, and to make proper allowance on their account. This treatise, and another on trigonometry, were continually reprinted, as the principal books for learning scientifically the art of navigation. What he had delivered, especially in the latter of them, concerning this subject, was contracted as a manual for sailors, in a very small piece called his *Epitome*; which useful performance has gone through a great number of editions. No alterations were ever made in the Seaman's Practice till the 12th edition in 1676, when the following paragraph was inserted in a smaller character: "About the year 1672, Monsieur Picart has published an account in French, concerning the measure of the earth, a breviate whereof may be seen in the Philosophical Transactions, N° 112, wherein he concludes one degree to contain 365,184 English feet, nearly agreeing with Mr Norwood's experiment;" and this advertisement is continued through the subsequent editions as late as the year 1732.

About the year 1645, Mr Bond published in Norwood's Epitome a very great improvement in Wright's method, by a property in his meridian line, whereby its divisions are more scientifically assigned than the author himself was able to effect; which was from this theorem, that these divisions are analogous to the excesses of the logarithmic tangents of half the respective latitudes augmented by 45 degrees above the logarithm of the radius. This he afterwards explained more fully in the third edition of Gunter's works, printed in 1653; where, after observing that the logarithmic tangents from 45° upwards increase in the same manner that the secants added together do, if every half degree be accounted as a whole degree of Mercator's meridional line. His rule for computing the meridional parts belonging to any two latitudes, supposed on the same side of the equator, is to the following effect: "Take the logarithmic tangent, rejecting the radius, of half each latitude, augmented by 45 degrees; divide the difference of those numbers by the logarithmic tangent of 45° 30′, the radius being likewise rejected; and the quotient will be the meridional parts required, expressed in degrees." This rule is the immediate consequence from the general theorem, That the degrees of latitude bear to one degree (or 60 minutes, which in Wright's table stands for the meridional parts of one degree), the same proportion as the logarithmic tangent of half any latitude augmented by 45 degrees, and the radius neglected, to the like tangent of half a degree augmented by 45 degrees, with the radius likewise rejected. But here was farther wanting the demonstration of this general theorem, which was at length supplied by Mr James Gregory of Aberdeen in his *Exercitationes Geometricæ*, printed at London in 1668; and afterwards more concisely demonstrated, together with a scientific determination of the divisor, by Dr Halley in the Philosophical Transactions for 1695, N° 219. from the consideration of the spirals into which the rhumbs are transformed in the stereographic projection of the sphere upon the plane of the equinoctial; and which is rendered still more simple by Mr Roger Cotes, in his Logometria, first published in the Philosophical Transactions for 1714, N° 388. It is moreover added in Gunter's book, that if $\frac{1}{20}$th of this division, which does not sensibly differ from the logarithmic tangent of 45° 1′ 30″ (with the radius subtracted from it), be used, the quotient will exhibit the meridional parts expressed in leagues, and this is the divisor set down in Norwood's Epitome. After the same manner the meridional parts will be found in minutes, if the like logarithmic tangent of 45° 1′ 30″, diminished by the radius, be taken; that is, the number used by others being 12633, when the logarithmic tables consist of eight places of figures besides the index.

In an edition of the Seaman's Kalender, Mr Bond declared, that he had discovered the longitude by having found out the true theory of the magnetic variation; and to gain credit to his assertion, he foretold, that at London in 1657 there would be no variation of the compass, and from that time it would gradually increase the other way; which happened accordingly. Again, In the Philosophical Transactions for 1668, N° 40. he published a table of the variation for 49 years to come. Thus he acquired such reputation, that his treatise, entitled, *The Longitude Found*, was in 1676 published by the special command of Charles II. and approved by many celebrated mathematicians. It was not long, however, before it met with opposition; and in 1678 another treatise, entitled, *The Longitude not Found*, made its appearance; and as Mr Bond's hy-

pothesis did not in any manner answer its author's sanguine expectations, the affair was undertaken by Dr Halley. The result of his speculation was, that the magnetic needle is influenced by four poles; but this wonderful phenomenon seems hitherto to have eluded all our researches. In 1700, however, Dr Halley published a general map, with curve lines expressing the paths where the magnetic needle had the same variation; which was received with universal applause. But as the positions of these curves vary from time to time, they should frequently be corrected by skilful persons; as was done in 1644 and 1756, by Mr William Mountaine, and Mr James Dodson, F. R. S. In the Philosophical Transactions for 1690, Dr Halley also gave a dissertation on the monsoons; containing many very useful observations for such as sail to places subject to these winds.

After the true principles of the art were settled by Wright, Bond, and Norwood, the authors on navigation became so numerous, that it would be impossible to enumerate them. New improvements were daily made, and every thing relative to it was settled with an accuracy not only unknown to former ages, but which would have been reckoned utterly impossible. The earth being found to be a spheroid, and not a perfect sphere, with the shortest diameter passing through the poles, a tract was published in 1741, by the Rev. Doctor Patrick Murdoch, wherein he accommodated Wright's sailing to such a figure; and Mr Colin Maclaurin, the same year, in the Philosophical Transactions, N° 461. gave a rule for determining the meridional parts of a spheroid; which speculation is farther treated of in his book of Fluxions, printed at Edinburgh in 1742.

Among the later discoveries in navigation, that of finding the longitude both by lunar observations and by time-keepers is the principal. It is owing chiefly to the rewards offered by the British parliament that this has attained the present degree of perfection. We are indebted to Dr Maskelyne for putting the first of these methods in practice, and for other important improvements in navigation. The time-keepers, constructed by Harrison for this express purpose, were found to answer so well, that he obtained the parliamentary reward.

The only works that have appeared of late in navigation are those on the longitude and navigation by Dr Mackay, of which the following account is transcribed from the Anti-Jacobin Review for September 1804.

"This publication, (Dr Mackay's Treatise on Navigation) and that on the longitude by the same author, form the most correct and practical system of navigation and nautical science hitherto published in this country; they may be considered not only of individual utility, but of national importance."

THEORY OF NAVIGATION.

THE motion of a ship in the water is well known to depend on the action of the wind upon its sails, regulated by the direction of the helm. As the water is a resisting medium and the bulk of the ship very considerable, it thence follows that there is always a great resistance on her fore-part; and when this resistance becomes sufficient to balance the moving force of the wind upon the sails, the ship attains her utmost degree of velocity, and her motion is no longer accelerated. This velocity is different according to the different strength of the wind; but the stronger the wind, the greater resistance is made to the ship's passage through the water: and hence, though the wind should blow ever so strong, there is also a limit to the velocity of the ship: for the sails and ropes can bear but a certain force of air; and when the resistance on the fore-part becomes more than equivalent to their strength, the velocity can be no longer increased, and the rigging gives way.

The direction of a ship's motion depends on the position of her sails with regard to the wind, combined with the action of the rudder. The most natural direction of the ship is, when she runs directly before the wind, the sails are then disposed, so as to be at right angles thereto. But this is not always the case, both on account of the variable nature of the winds, and the situation of the intended port, or of intermediate headlands or islands. When the wind therefore happens not to be favourable, the sails are placed so as to make an oblique angle both with the direction of the ship and with the wind; and the sails, together with the rudder, must be managed in such a manner, that the direction of the ship may make an acute angle with that of the wind; and the ship, making boards on different tacks, will by this means arrive at the intended port.

The reason of the ship's motion in this case is, that the water resists the side more than the fore-part, and that in the same proportion as her length exceeds her breadth. This proportion is so considerable, that the ship continually flies off where the resistance is least, and that sometimes with great swiftness. In this way of sailing, however, there is a great limitation: for if the angle made by the keel with the direction of the wind be too acute, the ship cannot be kept in that position; neither is it possible for a large ship to make a more acute angle with the wind than about 6 points; though small sloops, it is said, may make an angle of about 5 points with it. In all these cases, however, the velocity of the ship is greatly retarded; and that not only on account of the obliquity of her motion, but by reason of what is called her *lee-way*. This is occasioned by the yielding of the water on the lee-side of the ship, by which means the vessel acquires a compound motion, partly in the direction of the wind, and partly in that which is necessary for attaining the desired port.

It is perhaps impossible to lay down any mathematical principles on which the lee-way of a ship could be properly calculated; only we may see in general that it depends on the strength of the wind, the roughness of the sea, and the velocity of the ship. When the wind is not very strong, the resistance of the water on the lee-side bears a very great proportion to that of the current of air; and therefore it will yield but very little: however, supposing the ship to remain

remain in the same place, it is evident, that the water having once begun to yield, will continue to do so for some time, even though no additional force was applied to it; but as the wind continually applies the same force as at first, the lee-way of the ship must go on constantly increasing till the resistance of the water on the lee-side balances the force applied on the other, when it will become uniform, as doth the motion of a ship sailing before the wind. If the ship changes her place with any degree of velocity, then every time she moves her own length, a new quantity of water is to be put in motion, which hath not yet received any momentum, and which of consequence will make a greater resistance than it can do when the ship remains in the same place. In proportion to the swiftness of the ship, then, the lee-way will be the less: but if the wind is very strong, the velocity of the ship bears but a small proportion to that of the current of air; and the same effects must follow as though the ship moved slowly, and the wind was gentle; that is, the ship must make a great deal of lee-way.—The same thing happens when the sea rises high, whether the wind is strong or not; for then the whole water of the ocean, as far as the swell reaches, has acquired a motion in a certain direction, and that to a very considerable depth. The mountainous waves will not fail to carry the ship very much out of her course; and this deviation will certainly be according to their velocity and magnitude. In all cases of a rough sea, therefore, a great deal of lee-way is made.—Another circumstance also makes a variation in the quantity of the lee-way; namely, the lightness or heaviness of the ship; it being evident, that when the ship sinks deep in the water, a much greater quantity of that element is to be put in motion before she can make any lee-way, than when she swims on the surface. As therefore it is impossible to calculate all these things with mathematical exactness, it is plain that the real course of a ship is exceedingly difficult to be found, and frequent errors must be made, which can only be corrected by celestial observations.

In many places of the ocean there are *currents*, or places where the water, instead of remaining at rest, runs with a very considerable velocity for a great way in some particular direction, and which will certainly carry the ship greatly out of her course. This occasions an error of the same nature with the lee-way: and therefore, whenever a current is perceived, its direction and velocity ought to be determined, and the proper allowances made.

Another source of error in reckoning the course of a ship proceeds from the variation of the compass.

There are few parts of the world where the needle points exactly north; and in those where the variation is known, it is subject to very considerable alterations. By these means the course of the ship is mistaken; for as the sailors have no other standard to direct them than the compass, if the needle, instead of pointing due north, should point north-east, a prodigious error would be occasioned during the course of the voyage, and the ship would not come near the port to which she was bound. To avoid errors of this kind, the only method is, to observe the sun's amplitude and azimuth as frequently as possible, by which the variation of the compass will be perceived, and the proper allowances can then be made for errors in the course which this may have occasioned.

Errors will arise in the reckoning of a ship, especially when she sails in high latitudes, from the spherical figure of the earth; for as the polar diameter of our globe is found to be considerably shorter than the equatorial one, it thence follows, that the farther we remove from the equator, the longer are the degrees of latitude. Of consequence, if a navigator assigns any certain number of miles for the length of a degree of latitude near the equator, he must vary that measure as he approaches towards the poles, otherwise he will imagine that he hath not sailed so far as he actually hath done. It would therefore be necessary to have a table containing the length of a degree of latitude in every different parallel from the equator to either pole; as without this a troublesome calculation must be made at every time the navigator makes a reckoning of his course. Such a table, however, hath not yet appeared; neither indeed does it seem to be an easy matter to make it, on account of the difficulty of measuring the length even of one or two degrees of latitude in different parts of the world. Sir Isaac Newton first discovered this spheroidal figure of the earth; and showed, from experiments on pendulums, that the polar diameter was to the equatorial one as 229 to 230. This proportion, however, hath not been admitted by succeeding calculators. The French mathematicians, who measured a degree on the meridian in Lapland, made the proportion between the equatorial and polar diameters to be as 1 to 0.9891. Those who measured a degree at Quito in Peru, made the proportion 1 to 0.99624, or 266 to 265. M. Bouguer makes the proportion to be as 179 to 178; and M. Buffon, in one part of his theory of the earth, makes the equatorial diameter exceed the polar one by $\frac{1}{103}$ of the whole. According to M. du Sejour, this proportion is as 321 to 320; and M. de la Place, in his Memoir upon the Figure of Spheroids, has deduced the same proportion. From these variations it appears that the point is not exactly determined, and consequently that any corrections which can be made with regard to the spheroidal figure of the earth must be very uncertain.

It is of consequence to navigators in a long voyage to take the nearest way to their port; but this is scarcely possible to be done. The shortest distance between any two points on the surface of a sphere is measured by an arch of a great circle intercepted between them; and therefore it is advisable to direct the ship along a great circle of the earth's surface. But this is a matter of considerable difficulty, because there are no fixed marks by which it can be readily known whether the ship sails in the direction of a great circle or not. For this reason the sailors commonly choose to direct their course by the rhumbs, or the bearing of the place by the compass. These bearings do not point out the shortest distance between places; because, on a globe, the rhumbs are spirals, and not arches of great circles. However, when the places lie directly under the equator, or exactly under the same meridian, the rhumb then coincides with the arch of a great circle, and of consequence shows the nearest way. The sailing on the arch of a great circle is called *great circle sailing*; and the cases of it depend all on the solution of problems in spherical trigonometry.

PRACTICE OF NAVIGATION.

BOOK I.

Containing the Various Methods of Sailing.

INTRODUCTION.

THE art of navigation depends upon astronomical and mathematical principles. The places of the sun and fixed stars are deduced from observation and calculation, and arranged in tables, the use of which is absolutely necessary in reducing observations taken at sea, for the purpose of ascertaining the latitude and longitude of the ship, and the variation of the compass. The problems in the various sailings are resolved either by trigonometrical calculation, or by tables or rules formed by the assistance of trigonometry. By mathematics, the necessary tables are constructed, and rules investigated for performing the more difficult parts of navigation. For these several branches of science, and for logarithmic tables, the reader is referred to the respective articles in this work. A few tables are given at the end of this article; but as the other tables necessary for the practice of navigation are to be found in almost every treatise on that subject, it therefore seems unnecessary to insert them in this place.

CHAP. I. *Preliminary Principles.*

SECT. I. *Of the Latitude and Longitude of a Place.*

THE situation of a place on the surface of the earth is estimated by its distance from two imaginary lines intersecting each other at right angles: The one of these is called the *equator*, and the other the *first meridian*. The situation of the equator is fixed, but that of the first meridian is arbitrary, and therefore different nations assume different first meridians. In Britain, we esteem that to be the first meridian which passes through the royal observatory at Greenwich.

The equator divides the earth into two equal parts, called the *northern* and *southern hemispheres;* and the latitude of a place is its distance from the equator, reckoned on a meridian in degrees and parts of a degree; and is either north or south, according as it is in the northern or southern hemisphere.

The first meridian being continued round the globe, divides it into two equal parts, called the *eastern* and *western hemispheres;* and the longitude of a place is that portion of the equator contained between the first meridian and the meridian of the given place, and is either east or west; according as it is in the eastern or western hemisphere, respectively to the first meridian.

PROB. I. The latitudes of two places being given, to find the difference of latitude.

RULE. Subtract the less latitude from the greater, if the latitudes be of the same name, but add them if of contrary; and the remainder or sum will be the difference of latitude.

Example 1. Required the difference of latitude between the Lizard, in latitude 49° 57′ N. and Cape St Vincent, in latitude 37° 2′ N?

Latitude of the Lizard	49° 57′N.
Latitude of Cape St Vincent	37 2 N.
Difference of latitude	12 55=775 miles.

Ex. 2. What is the difference of latitude between Funchal, in latitude 32° 38′ N, and the Cape of Good Hope, in latitude 34° 29′ S?

Latitude of Funchal	32° 38′N.
Lat. of Cape of Good Hope	34 29 S.
Difference of latitude	67 7=4027 miles.

PROB. II. Given the latitude of one place, and the difference of latitude between it and another place, to find the latitude of that place.

RULE. If the given latitude and the difference of latitude be of the same name, add them; but if of different names, subtract them, and the sum or remainder will be the latitude required of the same name with the greater.

Ex. 1. A ship from latitude 39° 22′ N. sailed due north 560 miles—Required the latitude come to?

Latitude sailed from - - -	39° 22′N.
Difference of latitude 560′ - -	=9 20 N.
Latitude come to - - - -	48 42 N.

Ex. 2. A ship from latitude 7° 19′ N. sailed 854 miles south—Required the latitude come to?

Latitude sailed from - - - -	7° 19′N.
Difference of latitude 854′ -	=14 14 S.
Latitude come to - - -	6 55 S.

PROB. III. The longitudes of two places being given, to find their difference of longitude.

RULE. If the longitudes of the given places are of the same name, subtract the less from the greater, and the remainder is the difference of longitude: but if the longitudes are of contrary names, their sum is the difference of longitude. If this exceeds 180°, subtract it from 360°, and the remainder is the difference of longitude.

Ex. 1. Required the difference of longitude between Edinburgh and New York, their longitudes being 3° 14′ W. and 74° 10′ W. respectively?

Longitude of New York - -	74° 10′W.
Longitude of Edinburgh - -	3 14 W.
Difference of longitude - -	70 56.

Ex. 2. What is the difference of longitude between Maskelyne's Isles in longitude 167° 59′ E. and Olinde, in longitude 35° 5′ W?

Longitude

Latitude and Longitude.

Longitude of Maskelyne's Isles -	167°	59′ E.
Longitude of Olinde - -	35	5 W.
Sum - - - - -	203	4
Subtract from - - -	360	0
Difference of longitude - -	156	56

PROB. IV. Given the longitude of a place, and the difference of longitude between it and another place, to find the longitude of that place.

RULE. If the given longitude and the difference of longitude be of a contrary name, subtract the less from the greater, and the remainder is the longitude required of the same name with the greater quantity; but if they are of the same name, add them, and the sum is the longitude sought, of the same name with that given. If this sum exceeds 180°, subtract it from 360°, the remainder is the required longitude of a contrary name to that given.

Ex. 1. A ship from longitude 9° 54′ E. sailed westerly till the difference of longitude was 23° 18′.—Required the longitude come to?

Longitude sailed from - -	9°	54′ E.
Difference of longitude - -	23	18 W.
Longitude come to - - -	13	24 W.

Ex. 2. The longitude sailed from is 25° 9′ W. and difference of longitude 18° 46′ W.—Required the longitude come to?

Longitude left - - -	25°	9′ W.
Difference of longitude - -	18	46 W.
Longitude in - - - -	43	55 W.

SECT. II. *Of the Tides.*

THE theory of the tides has been explained under the article ASTRONOMY, and will again be farther illustrated under that of TIDES. In this place, therefore, it remains only to explain the method of calculating the time of high water at a given place.

As the tides depend upon the joint actions of the sun and moon, and therefore upon the distance of these objects from the earth and from each other; and as, in the method generally employed to find the time of high water, whether by the mean time of new moon, or by the epacts, or tables deduced therefrom, the moon is supposed to be the sole agent, and to have an uniform motion in the periphery of a circle, whose centre is that of the earth; it is hence obvious that method cannot be accurate, and by observation the error is sometimes found to exceed two hours. That method is therefore rejected, and another given, in which the error will seldom exceed a few minutes, unless the tides are greatly influenced by the winds.

PROB. I. To reduce the times of the moon's phases as given in the Nautical Almanac to the meridian of a known place.

RULE. To the time of the proposed phase, as given in the Nautical Almanac, apply the longitude of the place in time, by addition or subtraction, according as it is east or west, and it will give the time of the phase at the given place.

Ex. 1. Required the time of new moon at Salonique in May 1793?

Tides.

Time of new moon per Naut. Alm.	9d	15h	31′
Longitude of Salonique in time	0	1	33 E.
Time of new moon required, in May	9	17	4

Ex. 2. What is the time of the last quarter of the moon at Resolution bay in October 1793?

Time of last quarter per Naut. Alm.	26d	5h	47′
Longitude in time - -	0	9	17 W.
Time at Resolution bay of last quarter, October - - -	25	20	30, or 26th day at 8h 30′ A. M.

PROB. II. To find the time of high water at a known place.

RULE. In the Nautical Almanac seek in the given month, or in that immediately preceding or following it, for the time of that phase which happens nearest to the given day: reduce the time of this phase to the meridian of the given place by Prob. I. and take the difference between the reduced time and the noon of the given day.

Find the equation answering to this difference in Table VII. which applied to the time of high water on the day of new or full moon at the given place, according as the table directs, will give the approximate time of high water in the afternoon.

Now, take the interval between the reduced time of the phase and the approximate time of high water; find the corresponding equation, which applied as before to the syzigy time of high water, will give the time of the afternoon high water.

If the time of the morning high water is required, increase the last interval by 12 hours, if the given day falls before the phase, or diminish it by 12 hours when after that phase; and the equation to this time, applied to the syzigy time, gives the morning time of high water.

Ex. 1. Required the morning and afternoon times of high water at Leith, 11th December 1793?

Nearest phase to 11th Dec. is 1st quart.	9d	20h	29′
Longitude of Leith in time -	—0	0	13
Time at Leith of 1st quarter -	9	20	16
Given day - - - -	11	0	0
Difference - - - -	1	3	44
Time of H. W. at Leith-pier on syz.	0	2	20
Equat. from Tab. to 1d 3h 44′ -	+0	6	32
Approximate time of high water	11	8	52
Reduced time of 1st quarter -	9	20	16
Interval - - - -	1	12	36
Time of high water at Leith on syz.		2	20
Equat. from the Tab. to 1d 12h 36′		7	0
Time of high water at Leith		9	20 P.M.
Time of H. W. at Leith at full & change		2	20
Equat. to 1d 12h 36′—12h=1d 0h 36′		6	22
High water at Leith, Dec. 11th, at		8	42 A.M.

The time of high water found by the common method is about an hour and a half sooner.

Ex. 2. Required the time of high water at Funchal, 15th November 1793?

Tides.

The nearest phase to 15th November is that of full moon,		17d	8h 46′
Longitude of Funchal in time,	-	0	1 8 W.
Time of full moon at Funchal,	-	17	7 38
Given day, November	- -	15	0 0
Difference,	- - - - -	2	7 38
Time of high water at Funchal at full and change,	- - - - -	0	12 4
Equation from the Table to 2d 7h 38′ before full moon,	- -	—0	1 35
Approx. time of high water, Nov.		15	10 29
Reduced time of full moon,	-	17	7 38
Interval,	- - - - -	1	11 9
Time of high water at full and change,			12 4
Equation to 1d 11h before full moon,			0 56
Time of high water,	- - -		11 8P.M.

Equation to 1d 11h + 12h=1d 23h is 1h 15′, and 12h 4′—1h 15′=10h 49′=time of high water in the forenoon.

Ex. 3. Required the time of high water at Duskey Bay, 24th October 1793?

The nearest phase to the 24th October is the last quarter	- - - - - -	26d	5h 47′
Longitude of Duskey Bay in time,		+0	11 5 E.
Reduced time of first quarter of moon		26	16 52
Given day	- - - - -	24	0 0
Difference,	- - - - -	2	16 52
Time of high water at full and change,			10 57
Equation to 2d 16h 52′ before last quarter,	- - - - -	+	2 52
Approximate time of high water,			1 49
Change of equation to app. time 1h 49′			3
Time of high water in the afternoon,			1 52
Change of equation to 12 hours,	-		20
Time of high water in the morning,			1 32

Sect. III. *Of measuring a Ship's Run in a given Time.*

Ship's Run.

The method commonly used at sea to find the distance sailed in a given time, is by means of a log-line and half-minute glass. A description of these is given under the articles Log and Log-line; which see.

It has been already observed, that the interval between each knot on the line ought to be 50 feet, in order to adapt it to a glass that runs 30 seconds. But although the line and glass be at any time perfectly adjusted to each other, yet as the line shrinks after being wet, and as the weather has a considerable effect upon the glass, it will therefore be necessary to examine them from time to time; and the distance given by them must be corrected accordingly. The distance sailed may, therefore, be affected by an error in the glass, or in the line, or in both. The true distance may, however, be found as follows.

Prob. I. The distance sailed by the log, and the seconds run by the glass, being given, to find the true distance, the line being supposed right.

Rule.—Multiply the distance given by the log by 30, and divide the product by the seconds run by the glass, the quotient will be the true distance.

Ex. 1. The hourly rate of sailing by the log is nine knots, and the glass is found to run out in 35 seconds. Required the true rate of sailing?

9
30

35)270(7·7=true rate of sailing.

Ex. 2. The distance sailed by the log is 73 miles, and the glass runs out in 26 seconds. Sought the true distance?

73
30

26)2190(84.2 the true distance.

Prob. II. Given the distance sailed by the log, and the measured interval between two adjacent knots on the line; to find the true distance, the glass running exactly 30 seconds.

Rule. Multiply twice the distance, sailed by the measured length of a knot, point off two figures to the right, and the remainder will be the true distance.

Ex. 1. The hourly rate of sailing by the log is five knots, and the interval between knot and knot measures 53 feet. Required the true rate of sailing?

Measured interval	=	53
Twice hourly rate	=	10
True rate of sailing	=	5.30

Ex. 2. The distance sailed is 64 miles, by a log-line which measures 42 feet to a knot. Required the true distance?

Twice given distance,	=	120
Measured interval,		42
		256
		512
True distance,		53·76

Prob. III. Given the length of a knot, the number of seconds run by the glass in half a minute, and the distance sailed by the log: to find the true distance.

Rule. Multiply the distance sailed by the log by six times the measured length of a knot, and divide the product by the seconds run by the glass; the quotient, pointing off one figure to the right, will be the true distance.

Ex. The distance sailed by the log is 159 miles, the measured length of a knot is 42 feet, and the glass runs 33 seconds in half a minute. Required the true distance?

Distance by the log,		159
Six times length of a knot=42×6=252		
		318
		795
		318
Seconds run by the glass	=	33)40068(121.4= true distance.

Plane Sailing.

Chap. II. *Plane Sailing.*

Plane sailing is the art of navigating a ship upon principles deduced from the notion of the earth's being an extended plane. On this supposition the meridians are esteemed as parallel right lines. The parallels of latitude are at right angles to the meridians; the lengths of the degrees on the meridians, equator, and parallels of latitude, are everywhere equal; and the degrees of longitude are reckoned on the parallels of latitude as well as on the equator.—In this sailing four things are principally concerned, namely, the *course*, *distance*, *difference of latitude*, and *departure*.

The course is the angle contained between the meridian and the line described by the ship, and is usually expressed in points of the compass.

The distance is the number of miles a ship has sailed on a direct course in a given time.

The difference of latitude is the portion of a meridian contained between the parallels of latitude sailed from and come to; and is reckoned either north or south, according as the course is in the northern or southern hemisphere.

The departure is the distance of the ship from the meridian of the place she left, reckoned on a parallel of latitude. In this sailing, the departure and difference of longitude are esteemed equal.

Plate CCCLXIII.

In order to illustrate the above, let A (fig. 1.) represent the position of any given place, and AB the meridian passing through that place; also let AC represent the line described by a ship, and C the point arrived at. From C draw CB perpendicular to AB. Now in the triangle ABC, the angle BAC represents the course, the side AC the distance, AB the difference of latitude, and BC the departure.

In constructing a figure relating to a ship's course, let the upper part of what the figure is to be drawn on represent the *north*, then the lower part will be *south*, the right-hand side *east*, and the left-hand side *west*.

A north and south line is to be drawn to represent the meridian of the place from which the ship sailed; and the upper or lower part of this line, according as the course is southerly or northerly, is to be marked as the position of that place. From this point as a centre, with the chord of 60°, an arch is to be described from the meridian towards the right or left, according as the course is easterly or westerly; and the course, taken from the line of chords if given in degrees, but from the line of rhumbs if expressed in points of the compass, is to be laid upon this arch, beginning at the meridian. A line drawn through this point and that sailed from, will represent the distance, which if given must be laid thereon, beginning at the point sailed from. A line is to be drawn from the extremity of the distance perpendicular to the meridian; and hence the difference of latitude and departure will be obtained.

If the difference of latitude is given, it is to be laid upon the meridian, beginning at the point representing the place the ship left; and a line drawn from the extremity of the difference of latitude perpendicular to the meridian, till it meets the distance produced, will limit the figure.

Plane Sailing.

If the departure is given, it is to be laid off on a parallel, and a line drawn through its extremity will limit the distance. When either the distance and difference of latitude, distance and departure, or difference of latitude and departure, are given, the measure of each is to be taken from a scale of equal parts, and laid off on its respective line, and the extremities connected. Hence the figure will be formed.

Prob. I. Given the course and distance, to find the difference of latitude and departure.

Example. A ship from St Helena, in latitude 15° 55′ S. sailed S. W. by S. 158 miles. Required the latitude come to, and departure.

By Construction.

Draw the meridian AB (fig. 2.), and with the chord of 60° describe the arch *m n*, and make it equal to the rhumb of 3 points, and through *n* draw AC equal to 158 miles; from C, draw CB perpendicular to AB; then AB applied to the scale from which AC was taken, will be found to measure 131.4 and BC 87.8.

By Calculation.

To find the difference of latitude.

As radius - - -		10.00000
is to the cosine of the course	3 points	9.91985
so is the distance -	158 -	2.19866
to the difference of latitude	131.4 -	2.11851

To find the departure.

As radius - - -		10.00000
is to the sine of the course	3 points	9.74474
so is the distance -	158 -	2.19866
to the departure -	87.8 -	1.94340

By Inspection.

In the traverse table, the difference of latitude answering to the course 3 points, and distance 158 miles, in a distance column is 131.4, and departure 87.8.

By Gunter's Scale.

The extent from 8 points to 5 points, the complement of the course on the line of sine rhumbs (marked SR.) will reach from the distance 158 to 131.4, the difference of latitude on the line of numbers; and the extent from 8 points to 3 points on sine rhumbs, will reach from 158 to 87.8, the departure on numbers (A).

Latitude St Helena	=	15° 55′ S.
Difference of latitude	-	2 11 S.
Latitude come to	-	18 6 S.

Prob. II. Given the course and difference of latitude, to find the distance and departure.

Example.

(A) For the method of resolving the various problems in navigation, by the sliding gunter, the reader is referred to Dr Mackay's Treatise on the Description and Use of that Instrument.

Plane Sailing.

Example. A ship from St George's, in latitude 38° 45′ north, sailed SE ½ S: and the latitude by observation was 35° 7′ N. Required the distance run, and departure?

Latitude St George's	-	38° 45′ N
Latitude come to	-	35 7 N
Difference of latitude	-	3 38=218 miles.

By Construction.

Draw the portion of the meridian AB (fig. 3.) equal to 218 m.: from the centre A with the chord of 60° describe the arch *m n*, which make equal to the rhumb of 3½ points: through A *n* draw the line AC, and from B draw BC perpendicular to AB, and let it be produced till it meets AC in C. Then the distance AC being applied to the scale, will measure 282 m. and the departure BC 179 miles.

By Calculation.

To find the distance.

As radius	- - - - -	10.00000
is to the secant of the course	3½ points	10.11181
so is the difference of latitude	- 218 m.	2.33846
to the distance	- - 282 -	2.45027

To find the departure.

As radius	- - - - -	10.00000
is to the tangent of the course	3½ points -	9.91417
so is the difference of latitude	218 -	2.33846
to the departure	- - 178.9 -	2.25253

By Inspection.

Find the given difference of latitude 218 m. in a latitude column, under the course of 3½ points; opposite to which, in a distance column, is 282 miles; a departure column is 178.9 m. the distance and departure required.

By Gunter's Scale.

Extend the compass from 4½ points, the complement of the course, to 8 points on sine rhumbs, that extent will reach from the difference of latitude 218 miles, to the distance 282 miles in numbers; and the extent from 4 points to the course 3½ points on the line of tangent rhumbs (marked T. R.) will reach from 218 miles to 178.9, the departure on numbers.

Prob. III. Given course and departure, to find the distance and difference of latitude?

Example. A ship from Palma, in latitude 28° 37′ N. sailed NW. by W. and made 192 miles of departure: Required the distance run, and latitude come to?

By Construction.

Make the departure BC (fig. 4.) equal to 192 miles, draw BA perpendicular to BC, and from the centre C, with the chord of 60°, describe the arch *m n*, which make equal to the rhumb of 3 points, the complement of the course; draw a line through C *n*, which produce till it meets BA in A: then the distance AC being measured, will be equal to 231 m. and the difference of latitude AB will be 128.3 miles.

Plane Sailing.

By Calculation.

To find the distance.

As the sine of the course	5 points	9.91985
is to radius	- - - - -	10.00000
so is the departure	- 192	2.28330
to the distance	- - 230.9 -	2.36345

To find the difference of latitude.

As the tangent of the course	5 points	10.17511
is to radius	- - - - -	10.00000
so is the departure	- - 192	2.28330
to the difference of latitude	128.3	2.10819

By Inspection.

Find the departure 192 m. in its proper column above the given course 5 points; and opposite thereto is the distance 231 miles, and difference of latitude 138.3, in their respective columns.

By Gunter's Scale.

The extent from 5 points to 8 points on the line of sine rhumbs, being laid from the departure 192 on numbers, will reach to the distance 231 on the same line; and the extent from 5 points to 4 points on the line of tangent rhumbs, will reach from the departure 192, to the difference of latitude 128.3 on numbers.

Latitude of Palma	- - -	28° 37′ N
Difference of latitude	- - -	2 8 N
Latitude come to	- - -	30 45 N

Prob. IV. Given the distance and difference of latitude, to find the course and departure.

Example. A ship from a place in latitude 43° 13′ N. sails between the north and east 285 miles; and is then by observation found to be in latitude 46° 31′ N: Required the course and departure?

Latitude sailed from	- -	43° 13′ N
Latitude by observation	-	46 31 N
Difference of latitude	-	3 18=198 miles.

By Construction.

Draw the portion of the meridian AB (fig. 5.) equal to 198 miles; from B draw BC perpendicular to AB: then take the distance 285 miles from the scale, and with one foot of the compass in A describe an arch intersecting BC in C, and join AC. With the chord of 60° describe the arch *m n*, the portion of which, contained between the distance and difference of latitude, applied to the line of chords, will measure 46°, the course; and the departure BC being measured on the line of equal parts, will be found equal to 205 miles.

By Calculation.

To find the course.

As the distance	- - 285 -	2.45484
is to the difference of latitude	198 -	2.29660
so is the radius	- - - -	10.00000
to the cosine of the course	- 46° 0′ -	9.84176

To

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To find the departure.

As radius	-	-	10.00000
is to the sine of the course	46° 0′	-	9.85693
so is the distance	- 285	-	2.45484
to the departure	- 205	-	2.31177

By Inspection.

Find the given distance in the table in its proper column; and if the difference of latitude answering thereto is the same as that given, namely, 198, then the departure will be found in its proper column, and the course at the top or bottom of the page, according as the difference of latitude is found in a column marked *lat.* at top or bottom. If the difference of latitude thus found does not agree with that given, turn over till the nearest thereto is found to answer to the given distance. This is in the page marked 46 degrees at the bottom, which is the course, and the corresponding departure is 205 miles.

By Gunter's Scale.

The extent from the distance 285 to the difference of latitude 198 on numbers, will reach from 90° to 44°, the complement of the course on sines; and the extent from 90° to the course 46° on the line of sines being laid from the distance 285, will reach to the departure 205 on the line of numbers.

Prob. V. Given the distance and departure, to find the course and difference of latitude.

Example. A ship from Fort-Royal in the island of Grenada, in latitude 12° 9′ N, sailed 260 miles between the south and west, and made 190 miles of departure: Required the course and latitude come to?

By Construction.

Fig. 6. Draw BC (fig. 6.) perpendicular to AB, and equal to the given departure 190 miles; then from the centre C, with the distance 260 miles, sweep an arch intersecting AB in A, and join AC. Now describe an arch from the centre A with the chord of 60°, and the portion *m n* of this arch, contained between the distance and difference of latitude, measured on the line of chords, will be 47° the course; and the difference of latitude AB applied to the scale of equal parts, measures 177½ miles.

By Calculation.

To find the course.

As the distance	-	260	- 2.41497
is to the departure	-	190	- 2.27875
so is radius	-	-	- 10.00000
to the sine of the course		46° 57′	9.86378

To find the difference of latitude.

As radius	-	-	10.00000
is to the cosine of the course		46° 57′	9.83419
so is the distance	-	260	- 2.41497
to the difference of latitude		177.5	- 2.24916

By Inspection.

Seek in the traverse table until the nearest to the given departure is found in the same line with the given distance 260. This is found to be in the page marked 47° at the bottom, which is the course; and the corresponding difference of latitude is 177.3.

Plane Sailing.

By Gunter's Scale.

The extent of the compass, from the distance 260 to the departure 190 on the line of numbers, will reach from 90° to 47°, the course on the line of sines: and the extent from 90° to 43°, the complement of the course on sines, will reach from the distance 260 to the difference of latitude 177½ on the line of numbers.

Latitude Fort Royal	-	-	12° 9′ N
Difference of latitude	-	177 -	=2 57 S
Latitude in	-	-	9 12 N

Prob. VI. Given difference of latitude and departure, sought course and distance.

Example. A ship from a port in latitude 7° 56′ S, sailed between the south and east, till her departure is 132 miles; and is then by observation found to be in latitude 12° 3′ S. Required the course and distance?

Latitude sailed from	-	7° 56′ S.
Latitude in by observation		12 3 S.
Difference of latitude	-	4 7=247.

By Construction.

Draw the portion of the meridian AB (fig. 7.) equal Fig. 7. to the difference of latitude 247 miles; from B draw BC perpendicular to AB, and equal to the given departure 132 miles, and join AC: then with the chord of 60° describe an arch from the centre A; and the portion *m n* of this arch being applied to the line of chords, will measure about 28°; and the distance AC, measured on the line of equal parts, will be 280 miles.

By Calculation.

To find the course.

As the difference of latitude	-	247	2.39270
is to the departure	-	- 132	2.12057
so is radius	-	-	10.00000
to the tangent of the course		28° 7′	9.72787

To find the distance.

As radius	-	-	10.00000
is to the secant of the course		28° 7′	10.05454
so is the difference of latitude		247 -	2.39270
to the distance	-	280 -	2.44724

By Inspection.

Seek in the table till the given difference of latitude and departure, or the nearest thereto, are found together in their respective columns, which will be under 28°, the required course; and the distance answering thereto is 280 miles.

By Gunter's Scale.

The extent from the given difference of latitude 247 to the departure 132 on the line of numbers, will reach from 45° to 28°, the course on the line of tangents; and the extent from 62°, the complement of the course, to 90° on sines, will reach from the difference of latitude 247, to the distance 280 on numbers.

Chap. III. *Of Traverse Sailing.*

If a ship sail upon two or more courses in a given time, the irregular track she describes is called a *traverse*; and to resolve a traverse, is the method of reducing these several courses, and the distances run, in-

Traverse Sailing.

to a single course and distance. The method chiefly used for this purpose at sea is by inspection, which shall therefore be principally adhered to; and is as follows.

Make a table of a breadth and depth sufficient to contain the several courses, &c. This table is to be divided into six columns: the courses are to be put in the first, and the corresponding distances in the second column; the third and fourth columns are to contain the differences of latitude, and the two last the departures.

Now, the several courses and their corresponding distances being properly arranged in the table, find the difference of latitude and departure answering to each in the traverse table; remembering that the difference of latitude is to be put in a north or south column, according as the course is in the northern or southern hemisphere; and that the departure is to be put in an east column if the course is easterly, but in a west column if the course is westerly: Observing also, that the departure is less than the difference of latitude when the course is less than 4 points or 45°; otherwise greater.

Add up the columns of northing, southing, easting, and westing, and set down the sum of each at its bottom; then the difference between the sums of the north and south columns will be the difference of latitude made good, of the same name with the greater; and the difference between the sums of the east and west columns, is the departure made good, of the same name with the greater sum.

Now, seek in the traverse table, till a difference of latitude and departure are found to agree as nearly as possible with those above; then the distance will be found on the same line, and the course at the top or bottom of the page, according as the difference of latitude is greater or less than the departure.

In order to resolve a traverse by construction, describe a circle with the chord of 60°, in which draw two diameters at right angles to each other, at whose extremities are to be marked the initials of the cardinal points, north being uppermost.

Lay off each course on the circumference, reckoned from its proper meridian; and from the centre to each point draw lines, which are to be marked with the proper number of the course.

On the first radius lay off the first distance from the centre; and through its extremity, and parallel to the second radius, draw the second distance of its proper length; through the extremity of the second distance, and parallel to the third radius, draw the third distance of its proper length; and thus proceed until all the distances are drawn.

A line drawn from the extremity of the last distance to the centre of the circle will represent the distance made good: and a line drawn from the same point perpendicular to the meridian, produced, if necessary, will represent the departure; and the portion of the meridian intercepted between the centre and departure, will be the difference of latitude made good.

Examples.

I. A ship from Fyal, in lat. 38° 32′ N, sailed as follows: ESE 163 miles, SW ½ W 110 miles, SE ¾ S 180 miles, and N by E 68 miles. Required the latitude come to, the course, and distance made good?

By Inspection.

Course.	Dist.	Diff. of Latitude. N	Diff. of Latitude. S	Departure. E	Departure. W
ESE	163	—	62.4	150.6	—
SW ½ W	110	—	69.8	—	85.0
SE ¾ S	180	—	144.5	107.2	—
N 6 E	68	66.7	—	13.3	—
		66.7	276.7	271.1	85.0
			66.7	85.0	
S 41½ E	281		210.0	186.1	
Latitude left - -				38° 32′ N.	
Difference of latitude -				3 21 S.	
Latitude come to -				35 11 N.	

By Construction.

With the chord of 60° describe the circle NE, SW (fig. 8.), the centre of which represents the place the ship sailed from: draw two diameters NS, EW at right angles to each other; the one representing the meridian, and the other the parallel of latitude of the place sailed from. Take each course from the line of rhumbs, lay it off on the circumference from its proper meridian, and number it in order 1, 2, 3, 4. Upon the first rhumb C1, lay off the first distance 163 miles from C to A; through it draw the second distance AB parallel to C2, and equal to 110 miles; through B draw BD equal to 180 miles, and parallel to C3; and draw DE parallel to C4, and equal to 68 miles. Now CE being joined, will represent the distance made good; which applied to the scale will measure 281 miles. The arch S *n*, which represents the course, being measured on the line of chords, will be found equal to 41½°. From E draw EF perpendicular to CS produced; then CF will be the difference of latitude, and FE the departure made good; which applied to the scale will be found to measure 210 and 186 miles respectively. Fig. 3.

As the method by construction is scarcely ever practised at sea, it, therefore, seems unnecessary to apply it to the solution of the following examples.

II. A ship from latitude 1° 38′ S. sailed as under. Required her present latitude, course, and distance made good?

Course.	Dist.	Diff. of Latitude. N	Diff. of Latitude. S	Departure. E	Departure. W
NW 6 N	43	35.8	—	—	23.9
WNW	78	29.9	—	—	72.1
SE 6 E	56	—	31.1	46.6	—
WSW ½ W	62	—	18.0	—	59.3
N ¾ E	85	84.1	—	12.5	—
		149 8	49.1	59.1	155.3
		49.1			59.1
N 44° W	139	100.7 = 1° 41′			96.2
Latitude left -		1 38 S.			
Latitude come to		0 3 N.			

III.

Traverse Sailing.

III. Yesterday at noon we were in latitude 13° 12′ N, and since then have run as follows: SSE 36 miles, S 12 miles, NW ½ W 28 miles, W 30 miles, SW 42 miles, W*b*N 39 miles, and N 20 miles. Required our present latitude, departure, and direct course and distance?

Courses.	Dist.	Diff. of Latitude.		Departure.	
		N	S	E	W
SSE	36	—	33.3	3.8	—
S	12	—	12.0	—	—
NW ½ W	28	17.8	—	—	21.6
W	30	—	—	—	30.0
SW	42	—	29.7	—	29.7
W*b*N	39	7.6	—	—	38.2
N	20	20.0	—	—	—
		45.4	75.0	13.8	119.5
			45.4		13.8
S 74° W	110		29.6 = 0°30′		105.7
Yesterday's latitude -			13 12 N		
Present latitude -			12 42 N		

IV. The course per compass from Greigsness (B) to the May is SW ½ S, distance 58 miles; from the May to the Staples S*b*E ¾ E, 44 miles; and from the Staples to Flamborough Head S*b*E, 110 miles. Required the course per compass, and distance from Greigsness to Flamborough Head?

Courses.	Dist	Diff. of Latitude.		Departure.	
		N	S	E	W
SW ¼ S	58	—	43.0	—	38.9
S*b*E ¾ E	44	—	41.4	14.8	—
S*b*E	110	—	107.9	21.5	—
			192.3	36.3	38.9
					36.3
					2.6

Hence the course per compass is nearly S 1° W, and distance 192¼ miles.

Chap. IV. *Of Parallel Sailing.*

The figure of the earth is spherical, and the meridians gradually approach each other, and meet at the poles. The difference of longitude between any two places is the angle at the pole contained between the meridians of those places; or it is the arch of the equator intercepted between the meridians of the given places; and the meridian distance between two places in the same parallel, is the arch thereof contained between their meridians. It hence follows, that the meridian distance, answering to the same difference of longitude, will be variable with the latitude of the parallel upon which it is reckoned; and the same difference of longitude will not answer to a given meridian distance when reckoned upon different parallels.

Parallel Sailing.

Parallel sailing is, therefore, the method of finding the distance between two places lying in the same parallel whose longitudes are known; or, to find the difference of longitude answering to a given distance, run in an east or west direction. This sailing is particularly useful in making low or small islands.

In order to illustrate the principles of parallel sailing, let CABP (fig. 9.) represent a section of one fourth part of the earth, the arch ABP being part of a meridian; CA the equatorial, and CP the polar semi-axis. Also let B be the situation of any given place on the earth; and join BC, which will be equal to CA or CP (c). The arch AB, or angle ACB, is the measure of the latitude of the place B; and the arch BP, or angle BCP, is that of its complement. If BD be drawn from B perpendicular to CP, it will represent the cosine of latitude to the radius BC or CA. Fig 9.

Now since circles and similar portions of circles are in the direct ratio of their radii; therefore,

As radius
Is to the cosine of latitude;
So is any given portion of the equator
To a similar portion of the given parallel.

But the difference of longitude is an arch of the equator; and the distance between any two places under the same parallel, is a similar portion of that parallel.

Hence R : cosine latitude :: Diff. longitude : Distance.
And by inversion,
Cosine latitude : R :: Distance : Diff. of longitude.
Also,
Diff. of longitude : Distance :: R : cos. latitude.

Prob. I. Given the latitude of a parallel, and the number of miles contained in a portion of the equator, to find the miles contained in a similar portion of that parallel.

Ex. 1. Required the number of miles contained in a degree of longitude in latitude 55° 58′?

By Construction.

Draw the indefinite right line AB (fig. 10.); make the angle BAC equal to the given latitude 55° 58′, and AC equal to the number of miles contained in a degree of longitude at the equator, namely 60: from C draw CB perpendicular to AB; and AB being measured on the line of equal parts, will be found equal to 33.5, the miles required. Fig. 10.

(B) Greigsness is about 2½ miles distant from Aberdeen, in nearly a SE*b*E ½ E direction.

(C) This is not strictly true, as the figure of the earth is that of an oblate spheroid; and therefore the radius of curvature is variable with the latitude. The difference between CA and CP, according to Sir Isaac Newton's hypothesis, is about 17 miles.

Parallel Sailing.

By Calculation.

As radius - - -		10.00000
is to the cosine of latitude, -	55° 58′	9.74794
so is miles in a deg. of long. at eq.	60	1.77815
to the miles in a deg. in the given par.	33.58	1.52609

By Inspection.

To 56°, the nearest degree to the given latitude, and distance 60 miles, the corresponding difference of latitude is 33.6, which is the miles required.

By Gunter's Scale.

The extent from 90° to 34°, the complement of the given latitude on the line of sines, will reach from 60 to 33.6 on the line of numbers.

There are two lines on the other side of the scale, with respect to Gunter's line, adapted to this particular purpose; one of which is entitled *chords*, and contains the several degrees of latitude: The other, marked M. L. signifying *miles of longitude*, is the *line of longitudes*, and shows the number of miles in a degree of longitude in each parallel. The use of these lines is therefore obvious.

Ex. 2. Required the distance between Treguier in France, in longitude 3° 14′ W, and Gaspey Bay, in longitude 64° 27′ W, the common latitude being 48° 47′ N?

Longitude Treguier -	3° 14′ W	
Longitude Gaspey Bay	64 27 W	
Difference of longitude	61 13=3673′	
As radius - - -		10.00000
is to the cosine of latitude,	48° 47′ -	9.81882
so is the difference of longitude	3673 -	3.56502
to the distance -	2420 -	3.38384

Prob. II. Given the number of miles contained in a portion of a known parallel, to find the number of miles in a similar portion of the equator.

Example. A ship from Cape Finisterre, in latitude 42° 52′ N, and longitude 9° 17′ W, sailed due west 342 miles. Required the longitude come to?

By Construction.

Fig. 11. Draw the straight line AB (fig. 11.) equal to the given distance 342 miles, and make the angle BAC equal to 42° 52′, the given latitude: from B draw BC perpendicular to AB, meeting AC in C; then AC applied to the scale will measure 466½, the difference of longitude required.

By Calculation.

As radius - - -		10.00000
is to the secant of latitude,	42° 52′	10.13493
so is the distance -	342	2.53403
to the difference of longitude	466.6	2.66896

By Inspection.

The nearest degree to the given latitude is 43°; under which, and opposite to 171, half the given distance in a latitude column, is 234, in a distance column, which doubled gives 468, the difference of longitude.

If the proportional part answering to the difference between the given latitude and that used, be applied to the above, the same result with that found by calculation will be obtained. Parallel Sailing.

By Gunter's Scale.

The extent from 47° 8′, the complement of latitude to 60° on the line of sines, being laid the same way from the distance 342, will reach to the difference of longitude 466½ on the line of numbers.

Longitude Cape Finisterre -		9° 17′ W
Difference of longitude -		7 47 W
Longitude come to - -		17 4 W

Prob. III. Given the number of miles contained in any portion of the equator, and the miles in a similar portion of a parallel; to find the latitude of that parallel.

Example. A ship sailed due east 358 miles, and was found by observation to have differed her longitude 8° 42′. Required the latitude of the parallel?

By Construction.

Make the line AB (fig. 12.) equal to the given distance; to which let BC be drawn perpendicular, with an extent equal to 522′, the difference of longitude; describe an arch from the centre A, cutting BC in C; then the angle BAC being measured by means of the line of chords, will be found equal to 46°⅔, the required latitude. Fig. 12.

By Calculation.

As the distance -	358	2.55388
is to the difference of longitude,	522	2.71767
so is radius - - -		10.00000
to the secant of the latitude,	46°42′	10.16379

By Inspection.

As the difference of longitude and distance exceed the limits of the table, let therefore the half of each be taken; these are 261 and 179 respectively. Now, by entering the table with these quantities, the latitude will be found to be between 46 and 47 degrees. Therefore, to latitude 46°, and distance 261 miles, the corresponding difference of latitude is 181′.3, which exceeds the half of the given distance by 2′.3. Again, to latitude 47°, and distance 261, the difference of latitude is 170.0, being 1′.0 less than the half of that given: therefore the change of distance answering to a change of 1° of latitude is 3′.3.

Now, as 3′.3 : 2′.3 :: 1° : 42′.

Hence the latitude required is 46° 42′.

By Gunter's Scale.

The extent from 522 to 358 on the line of numbers, will reach from 90° to about 43°⅓, the complement of which 46⅔ is the latitude required.

Prob. IV. Given the number of miles contained in the portion of a known parallel, to find the length of a similar portion of another known parallel.

Example. From two ports in latitude 33° 58′ N, distance 348 miles, two ships sail directly north till they are in latitude 48° 23′ N. Required their distance?

By Construction.

Draw the line CB, CE (fig. 13.), making angles with Fig 13.

Parallel Sailing.

with CP equal to the complements of the given latitudes, namely, 56° 2′ and 41° 37′ respectively: make BD equal to the given distance 348 miles, and perpendicular to CP; now from the centre C, with the radius CB, describe an arch intersecting CE in E; then EF drawn from the point E, perpendicular to CP, will represent the distance required; which being applied to the scale, will measure 278½ miles.

By Calculation.

As the cosine of the latitude left	33° 58′	9.91874
is to the cosine of the lat. come to	48 23	9.82226
so is the given distance -	348	2.54158
to the distance required -	278.6	2.44510

By Inspection.

Under 34°, and opposite to 174, half the given distance in a latitude column is 210 in a distance column; being half the difference of longitude answering thereto. Now, find the difference of latitude to distance 210 miles over 48° of latitude, which is 140′.5; from which 1′.1 (the proportional part answering to 23 minutes of latitude) being subtracted, gives 139′.4 which doubled is 278′.8, the distance required.

By Gunter's Scale.

The extent from 56° 2′, the complement of the latitude left, to 41° 37′, the complement of that come to, on the line of sines, being laid the same way from 348, will reach to 278½, the distance sought on the line of numbers.

PROB. V. Given a certain portion of a known parallel, together with a similar portion of an unknown parallel; to find the latitude of that parallel.

Example. Two ships, in latitude 56° 0′ N, distant 180 miles, sail due south; and having come to the same parallel, are now 232 miles distant. The latitude of that parallel is required?

By Construction.

Fig. 14. Make DB (fig. 14.) equal to the first distance 180 miles, DM equal to the second 232, and the angle DBC equal to the given latitude 56°; from the centre C, with the radius CB, describe the arch BE; and through M draw ME parallel to CD, intersecting the arch BE in E; join EC and draw EF perpendicular to CD: then the angle FEC will be the latitude required; which being measured, will be found equal to 43° 53′.

By Calculation.

As the distance on the known parallel	180	2.25527
is to the distance on that required	232	2.36549
so is the cosine of the latitude left	56° 0′	9.74756
to the cosine of the latitude come to	43 53	9.85778

By Inspection.

To latitude 56°, and half the first distance 90 in a latitude column, the corresponding distance is 161, which is half the difference of longitude. Now 161, and 116, half the second distance, are found to agree between 43 and 44 degrees; therefore, to latitude 43° and distance 161, the corresponding difference of latitude is 117′.7; the excess of which above 116′ is 1′.7: and to latitude 44°, and distance 161, the difference of latitude is 115′.8: hence 117.7—115.8=1′.9, the change answering to a difference of 1° of latitude.

Middle Latitude Sailing.

Therefore, 1′.9 : 1′.7 :: 1° : 53′

Hence, the latitude is 43° 53′.

By Gunter's Scale.

The extent from 180 to 232 on the line of numbers, being laid in the same direction on the line of sines, from 34°, the complement of the latitude sailed from, will reach to 46° 7′, the complement of the latitude come to.

CHAP. V. *Of Middle Latitude Sailing.*

THE earth is a sphere, and the meridians meet at the poles; and since a rhumb-line makes equal angles with every meridian, the line a ship describes is, therefore, that kind of a curve called a *spiral*.

Let AB (fig. 15.) be any given distance sailed upon Fig. 15. an oblique rhumb, PBN, PAM the extreme meridians, MN a portion of the equator, and PCK, PEL two meridians intersecting the distance AB in the points CE infinitely near each other. If the arches BS, CD, and AR, be described parallel to the equator, it is hence evident, that AS is the difference of latitude, and the arch MN of the equator, the difference of longitude, answering to the given distance AB and course PAB.

Now, since CE represents a very small portion of the distance AB, DE will be the correspondent portion of a meridian: hence the triangle EDC may be considered as rectilineal. If the distance be supposed to be divided into an infinite number of parts, each equal to CE, and upon these, triangles be constructed whose sides are portions of a meridian and parallel, it is evident these triangles will be equal and similar; for, besides the right angle, and hypothenuse which is the same in each, the course or angle CED is also the same. Hence, by the 12th of V. Euc. the sum of all the hypothenuses CE, or the distance AB, is to the sum of all the sides DE, or the difference of latitude AS, as one of the hypothenuses CE is to the corresponding side DE. Now, let the triangle GIH (fig. Fig. 16. 16.) be constructed similar to the triangle CDE, having the angle G equal to the course: then as GH : GI :: CE : DC :: AB : AS.

Hence, if GH be made equal to the given distance AB, then GI will be the corresponding difference of latitude.

In like manner, the sum of all the hypothenuses CE, or the distance AB, is to the sum of all the sides CD, as CE is to CD, or as GH to HI, because of the similar triangles.

The several parts of the same rectilineal triangle will, therefore, represent the course, distance, difference of latitude, and departure.

Although the parts HG, GI, and angle G of the rectilineal triangle GIH, are equal to the corresponding parts AB, AS, and angle A, of the triangle ASB upon the surface of the sphere; yet HI is not equal to BS, for HI is the sum of all the arcs CD; but CD is greater than OQ, and less than ZX: therefore HI is greater than BS, and less than AR. Hence the difference of longitude MN cannot be inferred from the departure reckoned either upon the parallel sailed from, or on that come to, but on some intermediate parallel

Middle Latitude Sailing.

TV, such that the arch TV is exactly equal to the departure: and in this case, the difference of longitude would be easily obtained. For TV is to MN as the sine PT to the sine PM; that is, as the cosine of latitude is to the radius.

The latitude of the parallel TV is not, however, easily determined with accuracy; various methods have, therefore, been taken in order to obtain it nearly, with as little trouble as possible: first, by taking the arithmetical mean of the two latitudes for that of the mean parallel: secondly, by using the arithmetical mean of the cosines of the latitudes: thirdly, by using the geometrical mean of the cosines of the latitudes: and lastly, by employing the parallel deduced from the mean of the meridional parts of the two latitudes. The first of these methods is that which is generally used.

Fig. 17. In order to illustrate the computations in middle latitude sailing, let the triangle ABC (fig. 17.) represent a figure in plane sailing, wherein AB is the difference of latitude, AC the distance, BC the departure, and the angle BAC the course. Also, let the triangle DBC be a figure in parallel sailing, in which DC is the difference of longitude, BC the meridian distance, and the angle DCB the middle latitude. In these triangles there is, therefore, one side BC common to both; and that triangle is to be first resolved in which two parts are given, and then the unknown parts of the other triangle will be easily obtained.

PROB. I. Given the latitudes and longitudes of two places, to find the course and distance between them.

Example. Required the course and distance from the island of May, in latitude 56° 12′ N, and longitude 2° 37′ W, to the Naze of Norway, in latitude 57° 50′ N, and longitude 7° 27′ E?

Latitude isle of May -	56° 12′ N	- 56° 12′
Latitude Naze of Norway	57 50 N	- 57 50
Difference of latitude -	1 38 = 98′	- 114 2
Middle latitude -	-	- 57 1
Longitude isle of May -	-	2 37 W
Longitude Naze of Norway	-	7 27 E
Difference of longitude	-	10 4 = 604′

By Construction.

Fig. 18. Draw the right line AD (fig. 18.) to represent the meridian of the May; with the chord of 60° describe the arch *m n*, upon which lay off the chord of 32° 59, the complement of the middle latitude from *m* to *n*: from D through *n* draw the line DC equal to 604′, the difference of longitude, and from C draw CB perpendicular to AD: make BA equal to 98′, the difference of latitude, and join AC; which applied to the scale will measure 343 miles, the distance sought: and the angle A being measured by means of the line of chords, will be found equal to 73° 24′, the required course.

Middle Latitude Sailing.

By Calculation.

To find the course (D).

As the difference of latitude -	98′	-	1.99123
is to the difference of longitude	604	-	2.78104
so is the cosine of middle latitude	57° 1′	-	9.73591
to the tangent of the cosine -	73 24	-	10.52572

To find the distance.

As radius - - - - -			10.00000
is to the secant of the course	73° 24′	-	10.54411
so is the difference of latitude	98′	-	1.99123
to the distance - -	343	-	2.53534

By Inspection.

To middle latitude 57°, and 151 one-fourth of the difference of longitude in a distance column, the corresponding difference of latitude is 82.2.

Now 24.5, one fourth of the difference of latitude, and 82.2, taken in a departure column, are found to agree nearest in table marked $6\frac{1}{4}$ points at the bottom, which is the course; and the corresponding distance $85\frac{3}{4}$ multiplied by 4 gives 343 miles, the distance required.

By Gunter's Scale.

The extent from 98 the difference of latitude, to 604 the difference of longitude on numbers, being laid the same way from 33°, the complement of the middle latitude on sines, will reach to a certain point beyond the termination of the line on the scale. Now the extent between this point and 90° on sines, will reach from 45° to 73° 24′, the course on the line of tangents. And the extent from 73° 24′ the course, to 33° the complement of the middle latitude on the line of sines, being laid the same way from 604 the difference of longitude, will reach to 343 the distance on the line of numbers.

The true course, therefore, from the island of May to the Naze of Norway is N 73° 24′ E, ENE$\frac{1}{4}$E nearly; but as the variation at the May is $2\frac{1}{4}$ points west, therefore, the course per compass from the May is E$\frac{1}{2}$S.

PROB. II. Given one latitude, course, and distance sailed, to find the other latitude and difference of longitude.

Example. A ship from Brest, in latitude 48° 23′ N, and longitude 4° 30′ W, sailed SW$\frac{1}{4}$W 238 miles. Required the latitude and longitude come to?

By Construction.

With the course and distance construct the triangle ABC (fig. 17.), and the difference of latitude AB being measured, will be found equal to 142 miles: hence the latitude come to is 46° 1′ N, and the middle latitude 47° 12′. Now make the angle DCB equal Fig. 17.

to

(D) For R. : cosine mid. lat. :: Diff. of long. : Departure;
And diff. of lat. : Dep. :: R. : Tangent course.
Hence diff. of lat. : cosine mid. lat. :: diff. of long. : tang. course;
Or diff. of lat. : diff. of long. :: cosine mid. lat. : tang. course.

Middle Latitude Sailing.

to 47° 12′; and DC being measured, will be 281, the difference of longitude: hence the longitude come to is 9° 11′ W.

By Calculation.

To find the difference of latitude.

As radius	-	-	10.00000
is to the cosine of the course,	$4\frac{1}{4}$		9.77503
so is the distance,	- 238	-	2.37658
to the difference of latitude	141.8	-	2.15161
Latitude of Brest,	48° 23′ N	-	48° 23′ N
Difference of lat.	2 22 S		half 1 11 S
Lat. come to	46° 1′ N.	Mid. lat.	47 12

To find the difference of longitude (E).

As the cosine of Mid. Lat.	47° 12′	9.83215
is to the sine of the course	$4\frac{1}{4}$ points	9.90483
so is the distance -	238	2.37658
to the difference of longitude	281.3	2.44926
Longitude of Brest -	-	4° 30′W
Difference of longitude	- -	4 41 W
Longitude come to -	-	9 11W.

By Inspection.

To the course $4\frac{1}{4}$ points, and distance 238 miles, the difference of latitude is 141.8, and the departure 191.1. Hence the latitude come to is 46° 1′ N, and middle latitude 47° 12′. Then to middle latitude 47° 12′, and departure 191.1 in a latitude column, the corresponding distance is 281′, which is the difference of longitude.

By Gunter's Scale.

The extent from 8 points to $3\frac{1}{4}$ points, the complement of the course on sine rhumbs, being laid the same way from the distance 238, will reach to the difference of latitude 142 on the line of numbers; and the extent from 42° 48′ the complement of the middle latitude, to 53° 26′, the course on the line of sines, will reach from the distance 238 to the difference of longitude 281 on numbers.

Prob. III. Given both latitudes and course, required the distance and difference of longitude?

Example. A ship from St Antonio, in latitude 17° 0′ N, and longitude 24° 25′ W, sailed NW $\frac{1}{4}$ N, till by observation her latitude is found to be 28° 34′N. Required the distance sailed, and longitude come to?

Latitude St Antonio	17° 0 N	-	17° 0 N
Latitude by observation	28 34 N	-	28 34 N
Difference of lat.	11 34=694m.		45 34
		Middle lat.	22 47

By Construction.

Fig. 19. Construct the triangle ABC (fig. 19.), with the given course and difference of latitude, and make the angle BCD equal to the middle latitude. Now the distance AC and difference of longitude DC being measured, will be found equal to 864 and 558 respectively.

Middle Latitude Sailing.

By Calculation.

To find the distance.

As radius,	-	-	10.00000
is to the secant of the course	$3\frac{1}{4}$ points		10.09517
so is the difference of lat.	694	-	2.84136
To the distance	- 864	-	2.93653

To find the difference of longitude.

As the cosine of middle latitude	22° 47′	9.96472
is to the tangent of the course	$3\frac{1}{4}$ points	9.87020
so is the difference of latitude	694	2.84136
To the difference of longitude	558.3	2.74684
Longitude of St Antonio -	-	24° 25′ W
Difference of longitude -	-	9 18 W
Longitude come to -	-	33 43 W

By Inspection.

To course $3\frac{1}{4}$ points, and difference of latitude 231.3 one third of that given, the departure is 171.6 and distance 288, which multiplied by 3 is 864 miles.

Again to the middle latitude 22° 47′, or 23°, and departure 271.6 in a latitude column, the distance is 186, which multiplied by 3 is 558, the difference of longitude.

By Gunter's Scale.

The extent from $4\frac{1}{4}$ points, the complement of the course, to 8 points on the line of sine rhumbs, will reach from the difference of latitude 694 to the distance 864 on numbers; and the extent from the course 36° 34′ to 67° 13′, the complement of middle latitude on sines, will reach from the distance 864 to the difference of longitude 558 on numbers.

Prob. IV. Given one latitude, course, and departure, to find the other latitude, distance, and difference of longitude.

Example. A ship from latitude 26° 30′ N, and longitude 45° 30′ W, sailed NE $\frac{1}{2}$N till her departure is 216 miles. Required the distance run, and latitude and longitude come to?

By Construction.

With the course and departure construct the triangle ABC (fig. 20.), and the distance and difference of latitude being measured, will be found equal to 340 and 263 respectively. Hence the latitude come to is 30° 53′, and middle latitude 28° 42′. Now make the angle BCD equal to the middle latitude, and the difference of longitude DC applied to the scale will measure 246′. Fig. 20.

By Calculation.

To find the distance.

As the sine of the course	$3\frac{1}{2}$ points		9.80236
is to radius -	-	-	10.00000
so is the departure -	216	-	2.33445
To the distance -	340.5	-	2.53209

To

(E) This proportion is obvious, by considering the whole figure as an oblique-angled plane triangle.

Middle Latitude Sailing.

To find the difference of latitude.

As the tangent of the course	$3\frac{1}{2}$ points		9.91417
is to radius - - - -			10.00000
so is the departure -	216	-	2.33445
to the difference of lat.	263.2	-	2.42028
Latitude sailed from	26° 30′N		26° 30′N
Difference of latitude	4 23N	half	2 12N
Latitude come to	30 53 N.	Mid. lat.	28 42

To find the difference of longitude.

As radius - - -		10.00000
is to the secant of the mid. lat.	28° 42′	10.05693
so is the departure -	216	2.33445
to the difference of longitude	246.2	2.39138
Longitude left - - -		45° 30′W
Difference of longitude - -		4 6 E
Longitude come to - -		41 24 W

By Inspection.

Under the course $3\frac{1}{2}$ points, and opposite to 108, half the departure, the distance is 170, and difference of latitude $131\frac{1}{2}$; which doubled, give 340 and 263 for the distance and difference of latitude respectively.

Again, to middle latitude 28° 42′, and departure 108, the distance is 123; which doubled is 246 the difference of longitude.

By Gunter's Scale.

The extent from the course $3\frac{1}{2}$ points, on sine rhumbs, to the departure 216 on numbers, will reach from 8 points on sine rhumbs to about 340, the distance on numbers; and the same extent will reach from $4\frac{1}{2}$ points, the complement of the course, to 263, the difference of latitude on numbers; and the extent from 61° 18′ the complement of the middle latitude, to 90° on sines, will reach from the departure 216 to the difference of longitude 246 on numbers.

PROB. V. Given both latitudes and distance; to find the course and difference of longitude.

Example. From Cape Sable, in latitude 43° 24′N, and longitude 65° 39′W, a ship sailed 246 miles on a direct course between the south and east, and is then by observation in latitude 40° 48′N. Required the course and longitude in?

Latitude Cape Sable,	43° 24′N	43° 24′N
Latitude by observation,	40 48 N	40 48 N
Difference of latitude,	2 36=156′, sum	24 12
	Middle latitude	42 6

By Construction.

Fig. 21. Make AB (fig. 21.) equal to 156 miles; draw BC perpendicular to AB, and make AC equal to 246 miles. Draw CD, making with CB an angle of 42° 6′ the middle latitude. Now DC will be found to measure 256, and the course or angle A will measure 50° 39′.

By Calculation.

To find the course.

As the distance -	246	-	2.39093
is to the difference of latitude	156	-	2.19312
so is radius, - - -			10.00000
to the cosine of the course,	50° 39′		9.80219

To find the difference of longitude.

As the cosine of middle latitude	42° 6′	9.87039
is to the sine of the course	50 39	9.88834
so is the distance - -	246	2.39093
to the difference of longitude	256.4	2.40888
Longitude Cape Sable, - - -		65° 39′W
Difference of longitude - - -		4 16 E
Longitude come to - - -		61 23 W

Middle Latitude Sailing.

By Inspection.

The distance 246, and difference of latitude 156, are found to correspond above $4\frac{1}{2}$ points, and the departure is 190.1. Now, to the middle latitude 42°, and departure 190.1 in a latitude column, the corresponding distance is 256, which is the difference of longitude required.

By Gunter's Scale.

The extent from 246 miles, the distance, to 156, the difference of latitude on numbers, will reach from 90° to about $39°\frac{1}{2}$, the complement of the course on the line of sines: and the extent from 48°, the complement of the middle latitude, to $50°\frac{2}{3}$, the course on sines, will reach from the distance 246m. to the difference of longitude 256m. on numbers.

PROB. VI. Given both latitudes and departure; sought the course, distance, and difference of longitude.

Example. A ship from Cape St Vincent, in latitude 37° 2′N, longitude 9° 2′W, sails between the south and west; the latitude come to is 18° 16′N, and departure 838 miles. Required the course and distance run, and longitude come to?

Latitude Cape St Vincent,	37° 2′N		37° 2′
Latitude come to -	18 16N.		18 16
Difference of latitude	18 46=2126	sum	55 18
	Middle latitude		17 39

By Construction.

Make AB (fig. 22.) equal to the difference of latitude 1126 miles, and BC equal to the departure 838, and join AC; draw CD so as to make an angle with CB equal to the middle latitude 27° 39′. Then the course being measured on chords is about $36°\frac{2}{3}$, and the distance and difference of longitude, measured on the line of equal parts, will be found to be 1403 and 946 respectively. Fig. 22.

By Calculation.

To find the course.

As the difference of latitude	1126	3.05154
is to the departure - -	838	2.92324
so is radius - - - -		10.00000
to the tangent of the course	36° 39′	9.87170

To find the distance.

As radius - - - -		10.00000
is to the secant of the course	36° 39′	10.09566
so is the difference of latitude	1126	3.05154
to the distance - -	1403	3.14720

To

Middle Latitude Sailing.

To find the difference of longitude.

As radius - - -		10.00000
is to the secant of mid. lat. 27° 39′		10.05266
so is the departure - 838		2.92324
to the difference of longitude	946	2.97590
Longitude Cape St Vincent - -		9° 2′W
Difference of longitude - -		15 46W
Longitude come to - - -		24 48W

By Inspection.

One tenth of the difference of latitude 112.6 and of the departure 83.8, arc found to agree under $3\frac{1}{2}$ points, and the corresponding distance is 140, which multiplied by 10 gives 1400 miles. And to middle latitude $27°\frac{2}{3}$, and 209.5 one fourth of the departure in a latitude column, the distance is 236.5; which multiplied by 4 is 946, the difference of longitude.

By Gunter's Scale.

The extent from the difference of latitude 1126 to the departure 838 on numbers, will reach from 45° to $36°\frac{2}{3}$ the course on tangents; and the extent from $53°\frac{1}{3}$ the complement of the course to 90° on sines, will reach from 1126 to 1403 the distance on numbers. Lastly, the extent from $62°\frac{1}{3}$ the complement of the middle latitude, to 90° on sines, will reach from the departure 838 to the difference of longitude 946 on numbers.

Prob. VII. Given one latitude, distance, and departure, to find the other latitude, course, and difference of longitude.

Example. A ship from Bourdeaux, in latitude 44° 50′ N, and longitude 0° 35′ W, sailed between the north and west 374 miles, and made 210 miles of westing. Required the course, and the latitude and longitude come to?

By Construction.

With the given distance and departure make the triangle ABC (fig 23.). Now the course being measured on the line of chords is about $34°\frac{1}{6}$, and the difference of latitude on the line of numbers is 309 miles: hence the latitude come to, is 49° 59′ N, and middle latitude 47° 25′. Then make the angle BCD equal to 47° 25′, and DC being measured will be 310 miles, the difference of longitude. Fig. 23.

By Calculation.

To find the course.

As the distance -	374	2.57287
is to the departure -	210	2.32222
so is radius - - - -		10.00000
to the sine of the course	34° 10′	9.74935

To find the difference of latitude.

As radius - - -		10.00000
is to the cosine of the course	34° 10′	9.91772
so is the distance - -	374	2.57287
to the difference of latitude	309.4	2.49059
Latitude of Bourdeaux	44° 50′N	44° 50′
Difference of latitude	5 9N half	2 33
Latitude come to	49 59 N Mid. lat.	47 25

To find the difference of longitude.

Middle Latitude Sailing.

As radius - - -		10.00000
is to the secant of mid. lat.	47° 25′	10.16963
so is the departure - -	210	2.32222
to the difference of longitude	310.3	2.49185
Longitude of Bourdeaux - -		0° 35′W
Difference of longitude - -		5 10 W
Longitude in - - - -		5 45 W

By Inspection.

The half of the distance 187, and of the departure 105, are found to agree nearest under 34°, and the difference of latitude answering thereto is 155; which doubled is 310 miles.

Again, to middle latitude 47° 25′, and departure 105 in the latitude column, the corresponding distance is 155 miles, which doubled is 310 miles, the difference of longitude.

By Gunter's Scale.

The extent from the distance 374 miles to the departure 210 miles on the line of numbers, will reach from 90° to 34° 10′, the course on the line of sines; and the extent from 90° to 55° 50′, the complement of the course on sines, will reach from the distance 374 to the difference of latitude 309 miles on numbers.

Again, the extent from 42° 35′, the complement of the middle latitude, to 90° on sines, will reach from the departure 210 to the difference of longitude 310 on numbers.

Prob. VIII. Given one latitude, departure, and difference of longitude, to find the other latitude, course, and distance.

Example. A ship from latitude 54° 56′ N, longitude 1° 10′ W, sailed between the north and east, till by observation she is found to be in longitude 5° 26′ E, and has made 220 miles of easting. Required the latitude come to, course, and distance run?

Longitude left - - -	1° 10′W	
Longitude come to -	5 26 E	
Difference of longitude -	6 36=396	

By Construction.

Make BC (fig. 24.) equal to the departure 220, and CD equal to the difference of longitude 396:—then the middle latitude BCD being measured, will be found equal to 59° 15′: hence the latitude come to is 57° 34′, and difference of latitude 158°. Now make AB equal to 158, and join AC, which applied to the scale, will measure 271 miles. Also the course BAC being measured on chords will be found equal to $54°\frac{1}{3}$. Fig. 24.

By Calculation.

To find the middle latitude.

As the departure - -	220	2.34242
is to the diff. of longitude	396	2.59769
so is radius - - -		10.00000
To the secant of mid. lat.	56° 15′	10.25527
Double, mid. lat. -	112 30	
Latitude left - -	54 56	
Latitude come to -	57 34	
Diff. of latitude - -	2 38=158 miles	

Middle Latitude Sailing.

To find the course.

As the difference of latitude	158	2.19866
is to the departure -	220	2.34242
so is radius - - - - - -		10.00000
to the tangent of the course	54° 19′	10.14376

To find the distance.

As radius - - -		10.00000
is to the seeant of the course	54° 19′	10.23410
so is the difference of latitude	158	2.19866
to the distance - -	270.9	2.43276

By Inspection.

As the differences of longitude and departure exceed the limits of the tables, let, therefore, their halves be taken; these are 198 and 110 respectively. Now these are found to agree exactly in the page marked 5 points at the bottom. Whence the middle latitude is 56° 15′, and difference of latitude 158 miles.

Again, the difference of latitude 158 and departure 220 will be found to agree nearly above 54° the course, and the distance on the same line is 271 miles.

By Gunter's Scale.

The extent from the difference of longitude 396 to the departure 220 on numbers, will reach from 90° to 33° 45′, the complement of the middle latitude on sines; and hence the difference of latitude is 158 miles. Now the extent from 158 to 220 on numbers, will reach from 45° to 54°$\frac{1}{3}$ on tangents; and the extent from the complement of the course 35°$\frac{2}{3}$ to 90° on sines, will reach from the difference of latitude 158 to the distance 271 on numbers.

Prob. IX. Given the course and distance sailed, and difference of longitude; to find both latitudes.

Example. A ship from a port in north latitude, sailed S E $\frac{1}{4}$S 438 miles, and differed her longitude 7° 28′. Required the latitude sailed from, and that come to?

By Construction.

With the course and distance construct the triangle ABC (fig. 25.), and make DC equal to 448 the given difference of longitude. Now the middle latitude BCD will measure 48° 58′, and the difference of latitude AB 324 miles: hence the latitude left is 51° 40′, and that come to 46° 16′.

Fig. 25.

By Calculation.

To find the difference of latitude.

As radius - - -		10.00000
is to the cosine of the course	3$\frac{3}{4}$ pts.	9.86979
so is the distance -	438	2.64147
to the difference of latitude	324.5	2.51126

To find the middle latitude.

As the difference of longitude	448	2.65128
is to the distance - -	438	2.64147
so is the sine of the course -	3$\frac{3}{4}$ pts.	9.82708
to the consine of mid. latitude	48° 58′	9.81727
half difference of latitude	2 42	
Latitude sailed from -	51 40	
Latitude come to -	46 16	

Middle Latitude Sailing.

By Inspection.

To the course 3$\frac{3}{4}$ points, and half the distance 219 miles, the departure is 147.0, and difference of latitude 162.2; which doubled is 324.4. Again, to half the difference of longitude 224 in a distance column, the difference of latitude is 149.9 above 48°, and 146.9 over 49°.

Now, as 30 : 29 :: 60′ : 58′.

Hence the middle latitude is 48° 58′: the latitude sailed from is therefore 51° 40′, and latitude come to 46° 16′.

By Gunter's Scale.

The extent from 8 points to 4$\frac{1}{4}$ points, the complement of the course on sine rhumbs, will reach from the distance 438 miles to the difference of latitude 3245 on numbers. And the extent from the difference of longitude 448, to the distance 438 on numbers, will reach from the course 42° 11′ to the complement of the middle latitude 41° 2′ on sines. Hence the latitude left is 51° 40′, and that come to 46° 16′.

Prob. X. To determine the difference of longitude made good upon compound courses, by middle latitude sailing.

Rule I. With the several courses and distances find the difference of latitude and departure made good, and the ship's present latitude, as in traverse sailing.

Now enter the traverse table with the given middle latitude, and the departure in a latitude column, the corresponding distance will be the difference of longitude, of the same name with the departure.

Example. A ship from Cape Clear, in latitude 51° 18′ N, longitude 9° 46′ W, sailed as follows:—SW*b*S 34 miles, W*b*N 63 miles, NNW 48 miles, and NE$\frac{1}{2}$E 85 miles. Required the latitude and longitude come to?

Courses.	Dist.	Diff. of Latitude. N	Diff. of Latitude. S	Departure. E	Departure. W
SW*b*S	54	—	44.9	—	30.0
W*b*N	63	12.3	—	—	61.8
NNW	48	44.4	—	—	18.4
NE$\frac{1}{2}$E	85	53.9	—	65.7	—
		110.6	44.9	65.7	110.2
		44.9	—	—	65.7
			—	—	
N 34° W	79	65.7=1 6N			44.5

Latitude of Cape Clear 51 18N

Latitude come to 52 24N
Sum - - 103 42
Middle latitude 51 51

Now, to middle latitude 51° 51′ or 52°, and departure 44.5 in a latitude column, the difference of longitude is 72 in a distance column.

Longitude of Cape Clear 9 46 W
Difference of longitude 1 12 W
Longitude come to - 10° 58′W

The above method is not always practised to find the difference of longitude made good in the course of

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of a day's run; and will, no doubt, give the difference of longitude tolerably exact in any probable run a ship may make in that time, especially near the equator. But in a high latitude, when the distances are considerable, this method is not to be depended on.—To illustrate this, let a ship be supposed to sail from latitude 57° N, as follows: E 240 miles, N 240 miles, W 240 miles, and S 240 miles: then, by the above method, the ship will be come to the same place she left. It will, however, appear evident from the following consideration, that this is by no means the case; for let two ships, from latitude 61° N, and distant 240 miles, sail directly south till they are in latitude 57° N; now their distance being computed by Problem IV. of Parallel Sailing, will be 269.6 miles; and, therefore, if the ship sailed as above, she will be 29.6 miles west of the place sailed from; and the error in longitude will be equal to 240 × secant 61°—secant 57° = 29.6 × secant 57° = 54.4.

Theorems might be investigated for computing the errors to which the above method is liable. These corrections may, however, be avoided, by using the following method. Mercator's Sailing.

Rule II. Complete the traverse table as before, to which annex five columns; the first column is to contain the several latitudes the ship is in at the end of each course and distance; the second, the sums of each following pair of latitude; the third, half the sums, or middle latitudes; and the fourth and fifth columns are to contain the differences of longitude.

Now find the difference of longitude answering to each middle latitude and its corresponding departure, and put them in the east or west difference of longitude columns, according to the name of the departure. Then the difference of the sums of the east and west columns will be the difference of longitude made good, of the same name with the greater.

Example. A ship from Halliford in Iceland, in lat. 64° 30′ N, long. 27° 15′ W, sailed as follows: SSW 46 miles, SW 61 miles, S*b*W 59 miles, SE*b*E 86 miles, S*b*E¼E 79 miles. Required the lat. and long. come to?

Traverse Table.

Courses.	Dist.	Diff. of Lat. N	Diff. of Lat. S	Departure. E	Departure. W
SSW	46	—	42.5	—	17.6
SW	61	—	43.1	—	43.1
S*b*W	59	—	57.9	—	11.5
SE*b*E	86	—	47.8	71.5	—
S*b*E¼E	76	—	72.7	22.0	—
			264.0	93.5	72.2
				72.2	
				21.3	

By Rule I.

Latitude Halliford - -	64° 30′	N
Difference of latitude -	4 24	S
Latitude in - - -	60 6	N
Sum - - -	124 36	
Middle latitude - -	62 18	

Now, to middle lat. 62 18, and departure 21.3, the difference of long. is 46 E.

Long. Halliford - -	27 15	W
Longitude in - - -	16 29	

The error of comm. method, in this Ex. is 12′.

Longitude Table.

Successive Latitudes.	Sums.	Middle Latitudes.	Diff. of Longitude E	Diff. of Longitude W
64° 30′	—	—	—	—
63 48	128° 18′	64° 9′	—	40.4
63 5	126 53	63 27	—	96.4
62 7	125 12	62 36	—	25.0
61 19	123 26	61 43	150.9	—
60 6	121 25	60 43	45.0	—
			195.1	161.8
			161.8	
			34.1	

Difference of longitude -	34.1	
Longitude Halliford -	27.15	W
Longitude in - -	26.41	W

Chap. VI. *Of Mercator's Sailing.*

It was observed in Middle Latitude Sailing, that the difference of longitude made upon an oblique rhumb could not be exactly determined by using the middle latitude. In Mercator's sailing, the difference of longitude is very easily found, and the several problems of sailing resolved with the utmost accuracy, by the assistance of Mercator's chart or equivalent tables.

In Mercator's chart, the meridians are straight lines parallel to each other; and the degrees of latitude, which at the equator are equal to those of longitude, increase with the distance of the parallel from the equator. The parts of the meridian thus increased are called *meridional parts*. A table of these parts was first constructed by Mr Edward Wright, by the continual addition of the secants of each minute of latitude.

For by parallel sailing,

R : cos. of lat. :: part of equat. : similar part of parallel.

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And because the equator and meridian on the globe are equal; therefore,

R : cos. lat. :: part of meridian : similar part of parallel.

Or sec. lat. : R :: part of merid. : similar part of parallel.

Hence, $\frac{\text{secant latitude}}{\text{part of meridian}} = \frac{R}{\text{part of parallel}}$.

But in Mercator's chart the parallels of latitude are equal, and radius is a constant quality. If, therefore, the latitude be assumed successively equal to '1′, 2′, 3′,' &c. and the corresponding parts of the enlarged meridian be represented by a, b, c, &c.; then,

$\frac{\text{secant } 1'}{\text{part of mer. } a} = \frac{\text{secant } 2'}{\text{part of mer. } b.} = \frac{\text{secant } 3'}{\text{part of mer. } c.}$, &c.

Hence secant 1′ : part of mer. a :: secant 2′ : part of mer. b :: secant 3′ : part of mer. c, &c.

Therefore by 12th V. Euclid.

Secant 1′ : part of mer. a :: secant 1′ + secant 2′ + secant 3′, &c. : parts of $a+b+$ mer. c, &c.

That is, the meridional parts of any given latitude are equal to the sum of the secants of the minutes in that latitude (E).

Since CD : LK :: R : secant LD, fig. 15.

And in the triangle CED,

ED : CD :: R : tangent CED;

Therefore, ED : LK :: R² : secant LD × tangent CED

Hence $LK = \frac{ED \times \text{sec.} \times LD \times \text{tang. CED}}{R^2} = \frac{ED \times \text{sec. LD}}{R} \times \frac{\text{tang. CED}}{R}$.

But $\frac{ED \times \text{sec. LD}}{R}$ is the enlarged portion of the meridian answering to ED. Now the sum of all the quantities $\frac{ED \times \text{secant LD}}{R}$ corresponding to the sum of all the ED's contained in AS, will be the meridional parts answering to the difference of latitude AS; and MN is the sum of all the corresponding portions of the equator LK.

Whence MN = mer. diff. of lat. × tangent $\frac{CED}{R}$.

That is, the difference of longitude is equal to the meridional difference of latitude multiplied by the tangent of the course, and divided by the radius.

This equation answers to a right-angled rectilineal triangle, having an angle equal to the course; the adjacent side equal to the meridional difference of latitude, and the opposite side the difference of longitude. This triangle is, therefore, similar to a triangle constructed, with the course and difference of latitude, according to the principles of plane sailing, and the homologous sides will be proportional. Hence, if, in fig. 26. the angle A represents the course, AB the difference of latitude, and if AD be made equal to the meridional difference of latitude; then DE, drawn perpendicular to AD, meeting the distance produced to E, will be the difference of longitude.

Plate CCLXIV. fig. 26.

It is scarcely necessary to observe, that the meridional difference of latitude is found by the same rules as the proper difference of latitude; that is, if the given latitudes be of the same name, the difference of the corresponding meridional parts will be the meridional difference of latitude; but if the latitudes are of a contrary denomination, the sum of these parts will be the meridional difference of latitude.

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PROB. I. Given the latitudes and longitudes of two places, to find the course and distance between them.

Ex. Required the course and distance between Cape Finisterre, in latitude 42° 52′ N, longitude 9° 17′ W, and Port Praya in the island of St Jago, in latitude 14° 54′ N, and longitude 23° 29′ W?

Lat. Cape Finisterre	42° 52′	Mer. parts	2852
Latitude Port Praya	14 54	Mer. parts	904
Difference of lat. =	27 58	Mer. diff. lat.	1948
	1678		

Longitude Cape Finisterre	9° 17′ W
Longitude Port Praya -	23 29 W
Diff. longitude - -	14 12 = 852.

By Construction.

Draw the straight line AD (fig. 26.) to represent the meridian of Cape Finisterre, upon which lay off AB, AD equal to 1678, and 1948, the proper and meridional differences of latitude; from D draw DE perpendicular to AD, and equal to the difference of longitude 852, join AE, and draw BC parallel to DE; then the difference AC will measure 1831 miles, and the course BAC 23° 37′. Fig. 26.

By Calculation.

To find the course.

As the meridian difference of lat.	1948 -	3.28959
is to the difference of longitude -	852 -	2.93044
so is radius - - - - -		10.00000
to the tangent of the course 23° 37′ -		9.64085

To find the distance.

As radius - - - - -		10.00000
is to the secant of the course,	23° 37′ -	10.03798
so is the difference of latitude	1678 -	3.22479
to the distance - -	1831 -	3.26277

By Inspection.

As the meridian difference of latitude and difference of longitude are too large to be found in the tables, let the tenth of each be taken; these are 194.8 and 85.2 respectively. Now these are found to agree nearest under 24°; and to 167.8, one-tenth of the proper difference of latitude, the distance is about 183 miles, which multiplied by 10 is 1830 miles.

By Gunter's Scale.

The extent 1948, the meridional difference of latitude, to 852, the difference of longitude on the line of numbers, will reach from 45° to 23° 37′, the course on

(E) This is not strictly true; for instead of taking the sum of the secants of every minute in the distance of the given parallel from the equator, the sum of the secants of every point of latitude should be taken.

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on the line of tangents. And the extent from 66° 23′, the complement of the course to 90° on sines, will reach from 1678, the proper difference of latitude, to 1831, the distance on the line of numbers.

PROB. II. Given the course and distance, sailed from a place whose situation is known, to find the latitude and longitude of the place come to.

Example. A ship from Cape Hinlopen in Virginia, in latitude 38° 47′ N, longitude 75° 4′ W, sailed 267 miles NE*b*N. Required the ship's present place?

By Construction.

With the course and distance sailed, construct the triangle ABC (fig. 27.); and the difference of latitude AB being measured, is 222 miles: hence the latitude come to is 42° 29′ N, and the meridional difference of latitude 293. Make AD equal to 293; and draw DE perpendicular to AD, and meeting AC produced in E: then, the difference of longitude DE being applied to the scale of equal parts will measure 196; the longitude come to is therefore 71° 48′ W.

Fig. 27.

By Calculation.

To find the difference of latitude.

As radius	- -	10.00000
is to the cosine of the course,	- 3 points -	9.91985
so is the distance	- 267 -	2.42651
to the difference of latitude	- 222 -	2.34636
Lat. Cape Hinlopen	= 38° 47′ N.	Mer. parts 2528
Difference of lat.	- 3 42 N.	
Latitude come to	- 42 29 N.	Mer. parts 2821
Meridional difference of latitude		293

To find the difference of longitude.

As radius	- - - - -	10.00000
is to tangent of the course,	3 points -	9.82489
so is the mer. diff. of latitude	- 293 -	2.46687
to the difference of longitude	- 195.8 - -	2.29176
Longitude Cape Hinlopen	75° 4′ W	
Difference of longitude	- 3 16 E	
Longitude come to	71 48 W.	

By Inspection.

To the course 3 points, and distance 267 miles, the difference of latitude is 222 miles: hence the latitude in is 42° 29′, and the meridional difference of latitude 293. Again, to course three points, and 146.5 half the mer. difference of latitude, the departure is 97.9, which doubled is 195.8, the difference of longitude.

By Gunter's Scale.

The extent from 8 points to the complement of the course 5 points, on sine rhumbs, will reach from the distance 267 to the difference of latitude 222 on numbers; and the extent from 4 points to 3 points on tangent rhumbs, will reach from the meridional difference of latitude 293 to the difference of longitude 196 on numbers.

PROB. III. Given the latitudes and bearing of two places; to find their distance and difference of longitude.

Example. A ship from Port Canso in Nova Scotia, in latitude 45° 20′ N, longitude 60° 55′ W, sailed SE ¼ S, and by observation is found to be in latitude 41° 14′ N. Required the distance sailed, and longitude come to?

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Lat. Port Canso	- 45° 20′ N.	- Mer. parts - 3058
Lat. in by observation	41 14 N	- Mer. parts - 2720
Difference of lat.	- 4 6=246	Mer. diff. lat. 338

By Construction.

Make AB (fig. 28.) equal to 246, and AD equal to 338; draw AE, making an angle with AD equal to 3¼ points, and draw BC, DE perpendicular to AD. Now AC being applied to the scale, will measure 332, and DE 306.

Fig. 28

By Calculation.

To find the distance.

As radius	- - -	10.00000
is to the secant of the course,	- 3¼ points -	10.13021
so is the difference of latitude	- 246 - -	2.39093
to the distance	- 332 -	2.52114

To find the difference of longitude.

As radius	- -	10.00000
is to the tangent of the course,	- 3¼ points -	9.95729
so is the mer. diff. of latitude	- 338 - -	2.52892
to the difference of longitude	- 306.3 - -	2.48621
Longitude Port Canso	- 60° 55′ W	
Difference of longitude	- 5 6 E	
Longitude in	- - 53 49 W	

By Inspection.

Under the course 3¼ points, and opposite to half the difference of latitude 123 in a latitude column is 166 in a distance column, which doubled is 332 the distance; and opposite to 169, half the meridional difference of latitude in a latitude column, is 153 in a departure column, which doubled is 306, the difference of longitude.

By Gunter's Scale.

The extent from the complement of the course 4¼ points to 8 points on sine rhumbs, will reach from the difference of latitude 246 m. to the distance 332 on numbers; and the extent from 4 points, to the course 3¼ points on tangent rhumbs, will reach from the meridional difference of latitude 338 to the difference of longitude 306 on numbers.

PROB. IV. Given the latitude and longitude of the place sailed from, the course and departure; to find the distance, and the latitude and longitude of the place come to.

Example. A ship sailed from Sallee in latitude 33° 58′ N, longitude 6° 20′ W, the corrected course was NW*b*W½W, and departure 420 miles. Required the distance run, and the latitude and longitude come to?

By Construction.

With the course and departure construct the triangle ABC (fig. 29.); now AC and AB being measured, will be found to be equal to 476 and 224 respectively: hence

Fig. 29

Mercator's Sailing.

hence the latitude come to is 37° 42′ N, and meridional difference of latitude 276. Make AD equal to 276; and draw DE perpendicular thereto, meeting the distance produced in E; then DE applied to the scale will be found to measure 516′. The longitude in is, therefore, 14° 56′ W.

By Calculation.

To find the distance.

As radius - - -		10.00000
is to the cosecant of the course	5½ pts -	10.05457
so is the departure -	420 -	2.62325
to the distance -	476.2 -	2.67782

To find the difference of latitude.

As radius - - -		10.00000
is to the co-tangent of the course,	5½ pts -	9.72796
so is the departure -	420 -	2.62325
to the difference of latitude -	224.5	2.35121

Lat. of Sallee	33° 58′ N	Mer. parts	2169
Diff. of lat.	3 44 N		
Lat. in	37 42 N	Mer. parts	2445
Mer. difference of latitude -			276

To find the difference of longitude.

As radius - - -		10.00000
is to the tangent of the course	5½ pts -	10.27204
so is the mer. diff. of latitude	276 -	2.44091
to the difference of longitude	516.3 -	2.71295

Longitude of Sallee -	6° 20′ W	
Difference of longitude -	8 36 W	
Longitude in - -	14 56 W	

By Inspection.

Above 5½ points the course, and opposite to 210 half the departure, are 238 and 112; which doubled, we have 476 and 224, the distance and difference of latitude respectively. And to the same course, and opposite to 138, half the meridional difference of latitude, in a latitude column, is 258 in a departure column; which being doubled is 516, the difference of longitude.

By Gunter's Scale.

The extent from 5½ points, the course on sine rhumbs, to the departure 420 on numbers, will reach from eight points on sine rhumbs to the distance 476 on numbers; and from the complement of the course 2½ points on sine rhumbs, to the difference of latitude 224 on numbers.

Again, the extent from difference of latitude 224 to the meridional difference of latitude 276 on numbers, will reach from the departure 420 to the difference of longitude 516 on the same line.

PROB. V. Given the latitudes of two places, and their distance, to find the course and difference of longitude.

Example. A ship from St Mary's, in latitude 36° 57′ N, longitude 25° 9′ W, sailed on a direct course between the north and east 1162 miles, and is then by observation in latitude 49° 57′ N. Required the course steered, and longitude come to?

Lat. of St Mary's, -	36° 57′ N	Mer. parts	3470	Mercator's Sailing.
Lat. come to -	49 57 N	Mer. parts	2389	
Difference of lat. -	13 0	Mer. diff. lat.	1081	
	780			

By Construction.

Make AB (fig. 30.) equal to 780, and AD equal to 1081; draw BC, DE perpendicular to AD; make AC equal to 1162′, and through AC draw ACE. Then the course or angle A being measured, will be found equal to 47° 50′, and the difference of longitude DE will be 1194. Fig. 30.

By Calculation.

To find the course.

As the distance	1162 -	3.06521
is to the difference of latitude,	780 -	2.89209
so is radius - - -		10.00000
to the cosine of the course -	47° 50′ -	9.82688

To find the difference of longitude.

As radius - - -		10.00000
is to the tangent of the course,	47° 50′	10.04302
so is the mer. diff. of latitude	1081 -	3.03383
to the difference of longitude	1194 -	3.07685

Longitude of St Mary's -	25° 9′ W	
Difference of longitude -	19 54 E	
Longitude in - -	5 15 W	

By Inspection.

Because the distance and difference of latitude exceed the limits of the table, take the tenth of each; these are 116.2 and 78.0: Now these are found to agree nearest above 4½ points, which is therefore the course; and to this course, and opposite to 108.1, one tenth of the meridional difference of latitude, in a latitude column, is 119.3 in a departure column, which multiplied by 10 is 1193, the difference of longitude.

By Gunter's Scale.

The extent from the distance 1162 m. to the difference of latitude 780 m. on numbers, will reach from 90° to 42° 10′ in the line of sines. And the extent 45°, to the course 47° 50′ on the line of tangents, will reach from the meridional difference of latitude 1081 to the difference of longitude 1194 on numbers.

PROB. VI. Given the latitudes of two places, and the departure, to find the course, distance, and difference of longitude.

Example. From Aberdeen, in latitude 57° 9′ N, longitude 2° 8′ W, a ship sailed between the south and east till her departure is 146 miles, and latitude come to 53° 32′ N. Required the course and distance run, and longitude come to?

Latitude Aberdeen	57° 9′ N	Mer. parts	4199
Latitude come to	53 32 N	Mer. parts	3817
Difference of latitude	3 37 = 217′	Mer. diff. lat.	382

By Construction.

With the difference of latitude 217 m. and departure 146 m. construct the triangle ABC (fig. 31.), make Fig. 31.

AD

Mercator's Sailing.

AD equal to 382, draw DE parallel to BC, and produce AC to E: Then the course BAC will measure 33° 56′, the distance AC 261, and the difference of longitude DE 257.

By Calculation.

To find the course.

As the difference of latitude	217 -	2.33646
is to the departure - -	146 -	2.16435
so is radius - - - - -		10.00000
to the tangent of the course -	33° 56′ -	9.82789

To find the distance.

As radius - - - - -		10.00000
is to the secant of the course -	33° 56′	10.08109
so is the difference of latitude	217	2.33646
to the distance - -	261.5 -	2.41755

To find the difference of longitude.

As the difference of latitude	217 -	2.33646
is to the mer. diff. of latitude	382 -	2 58206
so is the departure - -	146 -	2.16435
to the difference of longitude	257 -	2.40995
Longitude of Aberdeen - - -		2° 8′ W
Difference of longitude - - -		4 17 E
Longitude come to - - - -		2 9 E

By Inspection.

The difference of latitude 217, and departure 146, are found to agree nearest under 34°, and the corresponding distance is 262 miles. To the same course, and opposite to 190.7, the nearest to 191, half the meridional difference of latitude, is 128.6 in a departure column, which doubled is 257, the difference of longitude.

By Gunter's Scale.

The extent from the difference of latitude 217, to the departure 146 on numbers, will reach from 45° to about 34°, the course on the line of tangents; and the same extent will reach from the meridional difference of latitude 382 to 257, the difference of longitude on numbers.—Again, the extent from the course 34° to 90 on sines, will reach from the departure 146 to the distance 261 on numbers.

PROB. VII. Given one latitude, distance and departure; to find the other latitude, course, and difference of longitude.

Example. A ship from Naples, in latitude 40° 51′ N, longitude 14° 14′ E, sailed 252 miles on a direct course between the south and west, and made 173 miles of westing. Required the course made good, and the latitude and longitude come to?

By Construction.

Fig. 32. With the distance and departure make the triangle ABC (fig. 32.) as formerly.—Now the course BAC being measured by means of a line of chords will be found equal to 43° 21′, and the difference of latitude applied to the scale of equal parts will measure 183′: hence the latitude come to is 37° 48′ N, and meridional difference of latitude 237.—Make AD equal to 237, and complete the figure, and the difference of longitude DE will measure 224′: hence the longitude in is 10° 30′ E.

Mercator's Sailing.

By Calculation.

To find the course.

As the distance - -	252 -	2.40140
is to the departure -	173 -	2.23805
so is radius - - - - -		10.00000
to the sine of the course -	43° 21′ -	9.83665

To find the difference of latitude.

As radius - - - - -		10.00000
is to the cosine of the course	43° 21′ -	9.86164
so is the distance - -	252 -	2.40140
to the difference of latitude	183.2 -	2.26304
Latitude of Naples	40° 51′ N. Mer. parts	2690
Difference of latitude	3 3 S.	
Latitude come to -	37 48 N. Mer. parts	2453
Meridional difference of latitude -		237

To find the difference of longitude.

As radius - - - - -		10.00000
is to the tangent of the course	43° 21′ -	9.97497
so is the mer. diff. of latitude -	237 -	2.37475
to the difference of longitude	223.7 -	2.34972
Longitude of Naples - - -		14° 14′ E
Difference of longitude - - -		3 44 W
Longitude in - - - -		10 30 E

By Inspection.

Under 43° and opposite to the distance 252 m. the departure is 171.8, and under 44°, and opposite to the same distance, the departure is 175.0.

Then as 3.2 : 1.2 :: 60′ : 22′.

Hence the course is 43° 22′.

Again, under 43° and opposite to 118.5, half the meridional difference of latitude in a latitude column, is 110.5 in a departure column; also under 44° and opposite to 118.5 is 114.4.

Then as 3.2 : 1.2 :: 3.9 : 1.5.

And 110.5 + 1.5 = 112, which doubled is 224, the difference of longitude.

By Gunter's Scale.

The extent from the distance 252 on numbers, to 90° on sines, will reach from the departure 173 on numbers, to the course 43⅓ on sines; and the same extent that will reach from the complement of the course 46°⅔ on sines will reach to the difference of latitude 183 on numbers.—Again, the extent from 45° to 43°⅓ on tangents will reach from the meridional difference of latitude 237, to the difference of longitude 224, on numbers.

PROB. VIII. Given one latitude, course, and difference of longitude: to find the other latitude and distance.

Example. A ship from Terceira, in latitude 38° 45′ N, longitude 27° 6′ W, sailed on a direct course, which, when corrected, was N 32° E, and is found by observation to be in longitude 18° 24′ W. Required the latitude come to, and distance sailed?

Longitude

Mercator's Sailing.

Longitude of Tercera	- -	27° 6′W
Longitude in	- - - - -	18 24 W
Difference of longitude	- - -	8 42=522

By Construction.

Fig. 33. Make the right-angled triangle ADE (fig. 33.) having the angle A equal to the course 32°, and the side DE equal to the difference of longitude 522: then AD will measure 835, which added to the meridional parts of the latitude left, will give those of the latitude come to 48° 46′; hence, the difference of latitude is 601: make AB equal thereto, to which let BC be drawn perpendicular; then AC applied to the scale will measure 708 miles.

By Calculation.

To find the meridional differeuce of latitudc.

As radius	- - - -		10.00000
is to the co-tangent of the course		32° 0′	10.20421
so is the difference of longitude		5 22	2.71767
to the mer. difference of latitude		8352	2.92188
Latitude of Tercera	30° 45′ N	Mer. parts	2526
		Mer. diff. of lat.	835
Latitude come to -	48 46N	Mer. parts	3361

Difference of latitude 10 1=601 miles.

To find the distance.

As radius	- - - -		10.00000
is to the secant of the course	-	32° 0′ -	10.07158
so is the difference of latitude	-	601 -	2.77887
to the distance	- -	707.7 -	2.85045

By Inspection.

To course 32°, and opposite to 130.5, one fourth of the given difference of longitude in a departure column, the difference of latitude is 208.8, which multiplied by 4 is 835, the meridional differencc of latitudc; hence the latitude in is 48° 46′ N, and difference of latitude 601.

Again, to the same course, and opposite to 200, one third of the differencc of latitude, the distance is 236, which multiplied by 3 gives 708 miles.

By Gunter's Scale.

The extent from the course 32°, to 45° on tangents, will reach from the difference of longitude 522 to the meridional difference of latitude 835 on numbers.—And the extent from the complement of the course 58° to 90° on sines, will reach from the difference of latitude 601, to the distance 708 miles on numbers.

Prob. IX. To find the difference of longitude made good upon compound courses.

Rule. With the several courses and distances, complete the Traverse Table, and find the difference of latitude, departure, and course made good, and the latitude come to as in Traverse Sailing. Find also the meridional difference of latitude.

Now to the course and meridional differencc of latitude, in a latitude column, the corresponding departure will be the difference of longitude, which applied to the longitude left will give the ship's present longitude.

Mercator's Sailing.

Example. A ship from port St Julian, in latitude 49° 10′ S, longitude 68° 44′ W, sailed as follows; ESE 53 miles, SE*b*S 74 miles, E by N 68 m. SE*b*E½E 47 miles, and E 84 miles. Required the ship's present place?

Courses.	Dist.	Diff. of Lat. N	Diff. of Lat. S	Departure. E	Departure. W
ESE	53		20.3	49.0	
SE*by*S	74		61.5	41.1	
E*by*N	68	13.3		66.7	
SE*by*E½E	47		22.1	41.5	
E	84			84.0	
		13.3	103.9	282.3	
			13.3		
S 72° E	197		90.6=1° 31′		

Latitude left, - 49 10 S m. pt. 3397

Latitude come to - 50 41 S m. pt. 3539

Mer. difference of latitude - - 142

Now to course 72°, and opposite to 71, half the mer. difference of latitude in a latitude column, is 218.7 in a departure column, which doubled is 437, the difference of longitude.

Longitude of Port St Julian - 68° 44′W

Difference of longitude - 7 17 E

Longitude come to - - 61 27 W

Although the above method is that usually employed at sea to find the difference of longitude, yet as it has been already observed, it is not to be depended on, especially in high latitudes, long distances, and a considerable variation in the courses, in which case the following method becomes necessary.

Rule II. Complete the Traverse Table as before, to which annex five columns. Now with the latitude left, and the several differences of latitude, find the successive latitudes, which are to be placed in the first of the annexed columns; in the second, the meridional parts corresponding to each latitude is to be put; and in the third, the meridional differences of latitude.

Then to each course, and correspouding meridional difference of latitude, find the difference of longitude, by Prob. VI. which place in the fourth or fifth columns, according as the coast is easterly or westerly; and the difference between the sums of these columns will be the difference of longitude made good upon the whole, of the same name with the greater.

Remarks.

1. When the course is north or south, there is no difference of longitude.

2. When the course is east or west, the difference of longitude cannot be found by Mercator's Sailing; in this case the following rule is to be used.

To the nearest degree to the given latitude taken as a course, find the distance answering to the departure in a latitude column: this distance will be the difference of longitude.

Ex.

Mercator's Sailing.

Ex. 1. Four days ago we took our departure from Faro-head, in latitude 58° 40′ N, and longitude 4° 50′ W, and since have sailed as follows: NW 32 miles, W 69 miles, WNW 93 miles, W*b*S 77 miles, SW 58 miles, and W¼S 49 miles.—Required our present latitude and longitude?

Mercator's Sailing.

Traverse Table.						Longitude Table.				
Courses.	Dist.	Diff. of Lat.		Departure.		Successive Latitudes.	Merid. Parts.	Merid. Diff. Lat	Diff of Longitude.	
		N	S	E	W				E	W
						58° 40′	4370			
NW	32	22.6			22.6	59 3	4415	45		45.0
W	69				69.0	59 3	4415	0		134.0
WNW	93	35.6			85.9	59 38	4484	69		166.5
W*b*S	77		15.0		75.5	59 23	4454	30		151.0
SW	58		41.0		41.0	58 42	4374	80		80.0
W¼S	49		7.2		48.5	58 35	4361	13		88.0
		58.2	63.2		342.5					664.5
			58.2			Longitude of Faro head -				4° 50′ W.
						Difference of longitude -				11 4 W.
W 1° S	343		5.0			Longitude in - -				15 54 W.

Ex. 2. A ship from latitude 78° 15′ N, longitude 28° 14′ E, sailed the following courses and distances. The latitude come to is required, and the longitude, by both methods: the bearing and distance of Hacluit's head-land, in latitude 79° 55′ N, longitude 11° 55′ E, is also required?

Traverse Table.						Longitude Table.				
Courses.	Dist.	Diff. of Lat.		Departure.		Successive Latitudes.	Merid. Parts.	Merid. Diff. Lat.	Diff. of Longitude.	
		N	S	E	W				E	W
						78° 15′	7817		—	
WNW	154	58.9	—	—	142.3	79 14	8120	303	—	731.7
SW	96	—	67.9	—	67.9	68 6	7774	346	—	346.0
NW¼W	89	56.4	—	—	68.8	79 2	8056	282	—	343.6
N*b*E	110	107.9	—	21.5	—	80 50	8676	620	123.6	—
NW¼N	56	45.0	—	—	33.4	81 35	8970	294	—	218.0
S*b*E¼E	78	—	73.4	26.3	—	80 22	8504	466	166.7	—
		268.2	141.3	47.8	312.4				290.3	1639.3
		141.3			47.8					290.3
		126.9			264.6					1349.0

By Rule I.

Latitude left	78° 15′ N.	Mer. pts.	7817
Diff. of latitude	2 7 N.		
Lat. come to -	80 22 N.	Mer. pts.	8504
Meridional diff. of latitude	-		687
As difference of lat. -	126.9	-	2.10346
is to mer. diff. of lat. -	687	-	2.83696
so is the departure -	264.6	-	2.42256
to diff. of longit. -	1432	-	3.15606
	23° 52′ W.		
Longitude left -	28 14 E.		
Longitude in -	4 22 E.		

The error of this method, in the present example, is therefore 1° 23′.

Longitude left - -	28° 14′ E.
Difference of longitude -	22 29 W.
Longitude in - -	5 45 E.

To find the bearing and distance of Hacluit's head-land.

Lat. H. H. = 79° 55′ N. M. P. 8347 Lon. 11° 55′ E.
Lat. ship. = 80 22 N. M. P. 8504 Lon. 5 45 E.

Diff. lat. 0 27 M. D. L. 157 D. L. 6 10

370

Now to 78.5 half the meridional difference of latitude, and 185.0 half the difference of longitude, the course 67°, and opposite to the difference of latitude 27, the distance is 69 miles.—Hence Hacluit's head-land bears S 67° E, distant 69 miles.

Method of resolving the Problems of Mercator's Sailing.

Chap. VII. *Containing the Method of resolving the several Problems of Mercator's Sailing, by the Assistance of a Table of Logarithmic Tangents.*

Prob I. Given one latitude, distance, and difference of longitude; to find the course, and other latitude.

Rule. To the arithmetical complement of the logarithm of the distance, add the logarithm of the difference of longitude in minutes, and the log. cosine of the given latitude; the sum rejecting radius will be the log. sine of the approximate course.

To the given latitude taken as a course in the traverse table, add half the difference of longitude in a distance column; the corresponding departure will be the first correction of the course, which is subtractive if the given latitude is the least of the two; otherwise, additive.

In Table A, under the complement of the course, and opposite to the first correction in the side column, is the second correction. In the same table find the number answering to the course at the top, and difference of longitude in the side column; and such part of this number being taken as is found in Table B opposite to the given latitude, will be the third correction. Now these two corrections, subtracted from the course corrected by the first correction, will give the true course.

Now the course and distance being known, the difference of latitude is found as formerly.

	Table A.									Table B.	
Arc.	10°	20°	30°	40°	50°	60°	70°	80°	90°	Lat.	
1°	3′	1	1′	1′	0′	0′	0′	0′	0′	0°	$\frac{1}{1}$
2	12	6	4	2	2	1	1	0	0	10	$\frac{1}{1}$
3	27	13	8	6	4	3	2	1	0	20	$\frac{1}{6}+\frac{1}{7}$
4	47	23	14	10	7	5	3	1	0	30	$\frac{1}{6}+\frac{1}{8}$
5	74	36	23	16	11	8	5	2	0	40	$\frac{1}{6}+\frac{1}{10}$
6	107	52	33	22	16	11	7	3	0	50	$\frac{1}{4}$
7	145	70	44	30	21	15	9	4	0	60	$\frac{1}{3}$
8	190	92	58	40	28	19	12	6	0	70	$\frac{1}{6}+\frac{1}{30}$
										80, &c.	$\frac{1}{6}$

Example. From latitude 50° N, a ship sailed 290 miles between the south and west, and differed her longitude 5°. Required the course, and latitude come to?

Distance - -	290. ar. co. log.	7.53760
Diff. of longitude -	300 log.	2.47712
Latitude - -	50° 0′ co. -	9.80807
Approximate course -	41 41 sine -	9.82279
To lat. 50°, and half diff. long. 150 in a dist. col. the first corr. in a dep. col. is 115 -		+1 55
Approximate course -	41 41	
Cor. - - -	1 55	
It table A to co. course 48° and 1st corr. 1° 55′ the second direction is		—0 2
To course 41° and diff. long. 5°, the number is 15, of which $\frac{1}{5}$ (Tab. B) being taken, gives		—0 3
True course - - - -		S. 43 31 W

To find the difference of latitude.

As radius - - - - -		10.00000
is to the cosine of the course	43° 33′ -	9.86020
so is the distance - -	290 -	2.46240
to the difference of latitude -	210.2	2.32260
Latitude left - - - -		50° 0′ N
Difference of latitude - - - -		3 30 S
Latitude come to - - - -		46 30 N

This problem was proposed, and resolved, by Mr Robert Hues in his *Treatise on the Globes*, printed at London in the year 1639, p. 181.

It was afterwards proposed by Dr Halley, in the second volume of the *Miscellanea Curiosa*, p. 34. in the following words:

A ship sails from a given latitude, and, having run a certain number of leagues, has altered her longitude by a given angle; it is required to find the course steered. And he then adds—*The solution hereof would be very acceptable, if not to the public, at least to the author of this tract, being likely to open some further light into the mysteries of geometry.*

Since that time, this problem has been solved in an indirect manner, by several writers on navigation, and others:—As Monsieur Bouguer, in his *Nouveau Traité de Navigation;* Mr Robertson, in the second volume of his *Elements of Navigation;* Mr Emerson, in his *Theory of Navigation*, which accompanies his *Mathematical Principles of Geography;* Mr Israel Lyons, in the *Nautical Almanack* for 1772; and Monsieur Bezout, in his *Traité de Navigation;* and lately, Baron Maseres, with the assistance of Mr Attwood, has given the first direct solution of this problem. For a comparison of the various solutions which have hitherto been made of this problem, the reader is referred to that by Dr Mackay, in the fourth and sixth volumes of Baron Maseres's *Scriptores Logarithmici.*

It was intended in this place to have given rules, to make allowance for the spheroidal figure of the earth: but as the ratio of the polar to the equatorial semi-axis is not as yet determined with sufficient accuracy, neither is it known if both hemispheres be similar figures; therefore these rules would be grounded on assumption only, and might probably err more from the truth

Oblique Sailing.

truth than those adapted to the spherical hypothesis. This therefore is supposed to be a sufficient apology for not inserting them.

Chap. VIII. *Of Oblique Sailing.*

Oblique sailing is the application of oblique-angled plane triangles to the solution of problems at sea. This sailing will be found particularly useful in going along shore, and in surveying coasts and harbours, &c.

Ex. 1. At 11h A. M. the Girdle Ness bore WNW, and at 2h P. M. it bore NW*b*N: the course during the interval S*b*W, five knots an hour. Required the distance of the ship from the Ness at each station?

By Construction.

Fig. 34. Describe the circle NE, SW (fig. 34.), and draw the diameters NS, EW, at right angles to each other: from the centre C, which represents the first station, draw the WNW line CF; and from the same point draw CH, S*b*W, and equal to 15 miles the distance sailed.—From H draw HF in a NW*b*N direction, and the point F will represent the Girdle Ness. Now the distances CF, HF will measure 19.1 and 26.5 miles respectively.

By Calculation.

In the triangle FCH are given the distance CH 15 miles, the angle FCH equal to 9 points, the interval between the S*b*W and WNW points, and the angle CHF equal to 4 points, being the supplement of the angle contained between the S*b*W and NW*b*N points; hence CFH is 3 points: to find the distances CF, HF.

To find the distance CF.

As the sine of CFH	- 3 points	-	9.74474
is to the sine of CHF	- 4 points	-	9.84948
so is the distance CH	15 miles	-	1.17609
to the distance CF	- 19.07	-	1.28083

To find the distance FH.

As the sine of CFH	- 3 points	-	9.74474
is to the sine of FCH	- points	-	9.99157
so is the distance CH	- 15 miles	-	1.17609
to the distance FH	- 26.48		1.42292

Ex. 2. The distance between the SE point of the island of Jersey and the island of Brehaut is 13 leagues: and the correct bearing and distance of Cape Frehel from the island of Brehaut is SE*b*E 26 miles. It is also known that the SE point of Jersey bears NNE from Cape Frehel: from whence the distance of these two is required, together with the bearing of the same point from the island of Brehaut?

By Construction.

Fig. 35. Describe a circle, (fig. 35.) and draw two diameters at right angles, the extremities of which will represent the cardinal points, north being uppermost.—Let the centre B represent Brehaut, from which draw the SE*b*E line BF equal to 26 miles, and the point F will represent Cape Frehel, from which draw the NNE line FI; make BI equal to 39 miles: Then FI applied to the scale will measure 34¼ miles, and the inclination of BI to the meridian will be found equal to 63°½.

Oblique Sailing.

By Calculation.

In the triangle BIF are given BI and BF equal to 39 miles, and 26 miles respectively; and the angle BFI equal to 7 points: To find the side FI, and angle FBI.

To find the angle BIF.

As the distance BI	- 39	-	1.59106
is to the distance BF	- 26	-	1.41497
so is the sine of BFI	- 78° 45′	-	9.99157
to the sine of BIF	- 40 50	-	9.81548
Sum - - - -	119 35		
Angle FBI - - -	60 25		
—— EBF - - -	33 45		
Difference, or EBI	- 26 40		

Bearing of Jersey from Brehaut N 63 20 E.

To find the distance FI.

As the sine of BFI	- 78° 45′	-	9.99157
is to the sine of FBI	- 60 25	-	9.93934
so is the distance BI	- 39 miles		1.59106
to the distance FI	- - 34.58	-	1.53883

Ex. 3. At noon Dungeness bore per compass N*b*W, distance 5 leagues; and having run NW*b*W 7 knots an hour, at 5 P. M. we were up with Beachyhead. Required the bearing and distance of Beachyhead from Dungeness?

By Construction.

Describe a circle (fig. 36.) to represent the horizon; Fig. 36. from the centre C draw the N*b*W line CD equal to 15 miles; and the NW*b*W line CB equal to 35 miles; join DB, which applied to the scale will measure about 26⅝ miles; and the inclination of DB to the meridian will be found equal to N 79°¾W.

By Calculation.

In the triangle DCB are given the distances CD, CB equal to 15 and 35 miles respectively; and the angle BCD equal to 4 points; to find the angles B and D, and the distance BD.

To find the angles.

Distance CB=35, sum of the ang. 16 points.
CD=15, angle C - 4

Sum -	50, angles B and D	12	
Difference	20, half sum	- 6 pts.	= 67° 30′
As the sum of the distances		- 50	- 1.69897
is to their difference		- 20	- 1.30103
so is the tang. of half sum angles		67 30	- 10.38378
to the tangent of half their diff.		44 0	- 9.98484
Angle CDB - -		111 30	
Supplement - -		68 30	
Angle, NCD - -		11 15	

Magnetic bearing - N 79 45 W. Or by allowing 2¼ points of westerly variation, the true bearing of Beachyhead from Dungeness will be W¼S nearly.

Oblique Sailing.

To find the distance.

As the sine of CDB	-	111° 30′	9.96868
is to the sine of BCD	-	45.0	9.84948
so is the distance BC	-	35 -	1.54407
to the distance BD	-	26.6	1.42487

Ex. 4. Running up Channel E*b*S per compass at the rate of 5 knots an hour. At 11^h A. M. the Eddistone lighthouse bore N*b*E$\frac{1}{4}$E, and the Start point NE*b*E$\frac{1}{4}$E; and at 4 P. M. the Eddistone bore NW*b*N, and the Start N$\frac{3}{4}$E. Required the distance and bearing of the Start from the Eddistone, the variation being 2$\frac{1}{4}$ points W?

By Construction.

Fig. 37. Let the point C (fig. 37.) represent the first station, from which draw the N*b*E$\frac{1}{4}$E line CA, the NE*b*E$\frac{1}{4}$E line CB, and the E*b*S line CD, which make equal to 25 miles the distance run in the elapsed time; then from D draw the NE*b*N line DA intersecting CA in A, which represents the Eddistone; and from the same point draw the N$\frac{3}{4}$E line DB cutting CB in B, which therefore represents the Start. Now the distance AB applied to the scale will measure 22.9, and the bearing per compass BAF will measure 73°$\frac{1}{2}$.

By Calculation.

In the triangle CAD are given CD equal to 25 miles, the angle CAD equal to 4$\frac{1}{4}$ points, the distance between N*b*E$\frac{1}{4}$E and NW*b*N; and the angle ADC equal to 4 points, the distance between the NW*b*N and W*b*N points; to find the distance CA.

As the sine of CAD	4$\frac{1}{4}$ points	-	9.86979
is to the sine of CDA	4 points	-	9.84948
so is the distance CD	25 miles	-	1.39794
to the distance CA	23.86	-	1.37763

In the triangle BCD, are given the distance CD 25 miles, the angle CBD 4$\frac{1}{2}$ points the interval between NE*b*E$\frac{1}{4}$ and N$\frac{3}{4}$E, and CDB 7$\frac{3}{4}$ points, the distance between W*b*N and N$\frac{3}{4}$E; to find the distance CD.

As the sine of CBD	-	4$\frac{1}{2}$ points	9.88819
is to the sine CDB	-	7$\frac{3}{4}$ points	9.99947
so is the distance CD	-	25 miles	1.39794
to the distance CB	-	32.3 -	1.50922

In the triangle CAB, the distances CA, CB, are given, together with the included angle ACB, equal to 4 points, the distance between N*b*E$\frac{1}{4}$E and NE*b*E$\frac{1}{4}$E; to find the angle CAB and distance AB.

Distance CB 32.3 Angle ACB - =45° 0′

Distance CA 23.86 Sum of CAB and ABC 135 0

Sum	56.16	Half - -	67 30
Difference	8.44		
As the sum of the distances		56.16 -	1.74943
is to their difference	-	8.44 -	0.92634
so is the tangent of half sum angles	-	67 30 -	10.38278
to the tangent of half diff. angles	-	19 56 -	9.55969
Angle CAB	- -	87 26	
Angle CAF	- -	14 4	
Bearing per compass.		S 73 22 E or ESE$\frac{1}{2}$E; and	

the variation 2$\frac{1}{4}$ points being allowed to the left of ESE$\frac{1}{2}$E, gives E$\frac{3}{4}$N, the true bearing of the Start from the Eddistone. Oblique Sailing.

To find the distance.

As the sine of CAB	87° 26′	-	9.99956
is to the sine of ACB	45 0′	-	9.84948
so is the distance CB	- 32.3		1.50922
to the distance AB	-	22.86	1.35914

Ex. 5. A ship from a port in latitude 57° 9′ N, longitude 2° 9′ W, sailed 82 miles on a direct course, and spoke a ship that had run 100 miles from a port in latitude 56° 21′ N, longitude 2° 50′ W.—Required the course of each ship, and the latitude and longitude come to?

Lat.	57° 9′ N	Mer. parts	4199	Lon.	2° 9′ W
56 21 N			4112	—	2 50 W
Diff. of lat.	48	Mer. diff. lat.	87	Diff. lon.	41

By Construction.

With the meridional difference of latitude, the difference of longitude, and difference of latitude, construct the triangles ADE, ABC (fig. 38.) as in Mer- Fig. 38. cator's Sailing; then A will represent the northernmost, and C the southernmost port, The distance AC applied to the scale will measure 53 miles, and the bearing BCA will be 25°$\frac{1}{4}$. From the points A and C, with distances equal to 82 and 100 miles respectively, describe arches interseeting each other in M, which will therefore be the place of meeting.—Now the angle ABM, the ship's course from the southernmost port, will measure N 80°$\frac{1}{2}$E; and the other ship's course, or angle BAM, will be 67°$\frac{4}{5}$, or ESE. From M draw the parallel MNP, and AN will be the difference of latitude made by the one ship, and CP that by the other ship: hence either of these being measured and applied to its correspondent latitude, will give 56° 38′, the latitude in. Make AF equal to 57, the meridional difference of latitude between the northernmost port and latitude in: from F draw FG perpendicular to AF, and produce AM to G, then FG will be the difference of longitude, which applied to the scale will measure 139: hence the longitude in, is 0° 10′ E.

By Calculation.

In the triangle ADE, ABC, are given AD equal to 87, DE equal to 41, and AB equal to 48; to find the angle BAC and distance AC.

To find the bearing of the ports.

As the meridional diff. of lat.	87	-	1.93952
is to the diff. of long.	-	41 -	1.61278
so is radius	- -	- -	10.00000
to the tangent of the bearing	25° 14′		9.67326

To find the distance of the ports.

As radius	- -	-	10.00000
is to the seeant of the bearing	-	25° 14′ -	10.04355
so is the diff. of latitude		48 -	1.68124
to the distance		53.06 -	1.72479

In the triangle AMC, the three sides are given to find the angles.

To

Oblique Sailing.

To find the angle ACM.

AM	- -	82		
MC	- -	100	ar.co.log. -	8.00000
AC	- -	53.06	ar.co.log. -	8.27523
Sum	- -	235.06	log. -	2.07015
Half	- -	117.53	log. -	1.55059
Difference	-	53.53		
				19.89597
		27 29	- cosine	9.94798
Angle ACM		54 58		
Angle BAC		25 14		

Southernmost ship's course } N.80 12 E

To find the angle MAC.

As AM	- - -	82	- 1.91381
is to MC	- - -	100	- 2.00000
so is the sine of ACM	-	54 58	- 9.91319
to the sine of MAC	-	93 3	- 9.99938
Angle BAC	- -	25 14	

Northernmost ship's course } S 67 49 E, or ESE.

In the right-angled triangle AMN, given AM, and the angle MAN, to find the differences of latitude AN:

As radius	- - - - - .		10.00000
is to the cosine of the course	67° 49′	-	9.57700
so is the distance	82	- -	1.91381
to the diff. of lat.	30.96		1.49081
Latitude of northernmost port	57 9	Mer. parts.	4199
Latitude in -	56 38	Mer. parts	4142
Meridional difference of latitude -			57

To find the difference of longitude FG

As radius	- -		10.00000
is to the tangent of the course	67° 49′		10.38960
so is the mer. diff. of lat.	57	- - -	1.75587
to the diff. of long.	139.8	-	2.14547
Longitude left -	-	2° 9′ W	
Difference of longitude -		2 20 E	
Longitude in -	-	0 11	

Chap. IX. *Of Windward Sailing.*

Windward sailing is, when a ship by reason of a contrary wind is obliged to sail on different tacks in order to gain her intended port; and the object of this sailing is to find the proper course and distance to be run on each tack.

Ex. 1. A ship is bound to a port 48 miles directly to the windward, the wind being SSW, which it is intended to reach on two boards; and the ship can lie within six points of the wind. Required the course and distance on each tack?

Windward Sailing.

By Construction.

Draw the SSW line CB (fig. 39.) equal to 48 miles. Make the angles ACB, ABC, each equal to 6 points. Hence the first course will be W, and the second SE: also the distance CA, or AB, applied to the scale, will measure 62¾ miles, the distance to be sailed on each board. Fig. 39.

By Calculation.

From A draw AD perpendicular to BC; then in the triangle ADC are given CD equal to 24 miles; and the angle ACD, equal to 6 points, to find the distance AC.

As radius	-	-	10.00000
is to the secant of C	-	6 points -	10.41716
so is CD		24 miles -	1.38021
to CA	- -	62.7 -	1.79737

Ex. 2. The wind at NW, a ship bound to a port 64 miles to the windward, proposes to reach it on three boards; two on the starboard, and one on the larboard tack, and each within 5 points of the wind. Required the course and distance on each tack?

By Construction.

Draw the NW line CA (fig. 40.) equal to 64 miles; from C draw CB W*b*S, and from A draw AD parallel thereto, and in an opposite direction; bisect AC in E, and draw BED parallel to the N*b*E rhumb, meeting CB, AD in the points B and D: then CB=AD applied to the scale will measure 36¼ miles, and BD=2CB=72½ miles. Fig. 40.

By Calculation.

From B draw BF perpendicular to AC; then, in the triangle BFC are given the angle BCF equal to 5 points, and CF equal to one-fourth of CA=16 m. to find CB.

As radius	- - - - -		10.00000
is to the secant of BCF	-	5 points -	10.25526
so is CF	- - -	16 m. -	1.20412
to CB	- -	36.25 -	1.55938

Ex. 3. A ship which can lie within 5½ points of the wind, is bound to a port 36 miles to the windward, the wind being NE*b*N, which it is intended to reach on four boards, the first being on the larboard tack. Required the course and distance on each?

By Construction.

Draw the NE*b*N line CA (fig. 41.) equal to 36 miles, and bisect it in B; from C and B draw lines parallel to the E½S rhumb; and from A and B draw lines parallel to the SSE½E point, meeting the former in the points D and E. Now the distances AD, BD, BE, and CE, are equal; and any one of them applied to the scale will measure 19.1 miles. Fig. 41.

By Calculation.

From E draw EF perpendicular to AC; and in the triangle CFE are given CF=9 m. and the angle FCE =5½ points, to find CE.

Windward Sailing.

As radius	- -	-	10.00000
is to the secant of FCE	-	5½ points	10.32661
so is CF	- -	9 miles	0.95424
to the distance CE	-	19.1 miles	1.28085

Ex. 4. A ship bound to a port bearing N*b*W distant 40 miles, with the wind at N*b*E½E, intends to reach it on two boards. Required the course and distance on each tack, the ship lying within 5½ points of the wind?

By Construction.

Fig. 42. Draw the N*b*W line CA (fig. 42.) equal to 40 miles; and because the wind is N*b*E½E, and the ship can lie within 5½ points of the wind, the course on the larboard tack will be E*b*N, and on the starboard NW. Therefore, from the centre C draw the E*b*N line CB, and from it draw the NW line AB, meeting CB in B; then CB and AB applied to the scale will measure 26.7 and 48.1 m. respectively.

By Calculation.

In the triangle ACB, given AC=40 miles, and the angles A, B, and C, equal to 3, 5, and 8 points respectively, to find AB and BC.

To find the distance CB.

As the sine of B	- -	5 points	9.91985
is to the sine of A	- -	3 points	9.74474
so is the distance CA	-	40 miles	1.60206
to the distance CB	- -	26.73	1.42695

To find the distance AB.

As the sine of B	- -	5 points	9.91985
is to the sine of C	- -	8 points	10.00000
so is the distance CA	-	40 miles	1.60206
to the distance AB	-	48.11	1.68221

Ex. 5. A ship close hauled within 5 points of the wind, and making one point of leeway, is bound to a port bearing SSW distant 54 miles, the wind being S*b*E: It is intended to make the port at three boards, the first of which must be on the larboard tack in order to avoid a reef of rocks. Required the course and distance on each tack?

By Construction.

Fig. 43. Draw the SSW line CA (fig. 43.) equal to 54 m. and as the wind is S*b*E, and the ship makes her course good within 6 points of the wind, therefore the course on the larboard tack will be SW*b*W, and on the starboard E*b*S: hence from C draw the SW*b*W line CB, and from A draw AD parallel thereto; bisect CA in E, and draw BED parallel to the E*b*S line; then will CB and AD be the distances on the larboard tack, which applied to the scale, each will be found to measure 37.4; and the distance on the starboard tack BD will measure 42.4 miles.

By Calculation.

The triangles CBE, EAD are equal and similar: hence in the first of these are given CE, equal to 27 miles, half the distance between the ship and port; the angles C, B, and E, equal to 3, 4, and 9 points respectively, to find CB and BE.

To find CB, the distance on the larboard tack. Current Sailing.

As the sine of B	- -	4 points	9.84948
is to the sine of E	- -	9 points	9.99157
so is the distance CE	-	27 miles	1.43136
to the distance BC	- -	37.45	1.57345

To find BE half the distance on the starboard tack.

As the sine of B	- -	4 points	9.84948
is to the sine of C	- -	3 points	9.74474
so is the distance CE	-	27 miles	1.43136
to the distance BE	- -	21.21	1.32662
Whole distance AC	-	42.42	

Ex. 6. A ship plying to the windward, with the wind at NNE, after sailing 51 miles on each of two tacks, is found by observation to have made 36 miles of difference of latitude. How near the wind did she make her way good?

By Construction.

Make CA (fig. 44.) equal to 36 miles; draw AB Fig. 44. perpendicular to CA, and draw the NNE line CB, meeting AB in B; make CD, BD each equal to 51 miles, and these being measured, will be found equal to 6 points.

By Calculation.

In the triangles CAB, BCD, are given AB equal to 36 m. CD=BD=51, and the angle ACB equal to 2 points; to find the angle BCD.

As the distance CD	-	51	1.70757
is to the diff. of latitude CA	-	18	1.25527
so is the secant of ACB	-	2 points	10.03438
to the cosine of BCD	-	67° 32′	9.58208

Chap. X. *Of Current Sailing.*

The computations in the preceding chapters have been performed upon the assumption that the water has no motion. This may no doubt answer tolerably well in those places where the ebbings and flowings are regular, as then the effect of the tide will be nearly counterbalanced. But in places where there is a constant current or setting of the sea towards the same point, an allowance for the change of the ship's place arising therefrom must be made: And the method of resolving these problems, in which the effect of a current, or heave of the sea, is taken into consideration, is called *current sailing*.

In a calm, it is evident a ship will be carried in the direction and with the velocity of the current. Hence, if a ship sails in the direction of the current, her rate will be augmented by the rate of the current; but if sailing directly against it, the distance made good will be equal to the difference between the ship's rate as given by the log and that of the current. And the absolute motion of the ship will be a-head, if her rate exceeds that of the current; but if less, the ship will make sternway. If the ship's course be oblique to the current, the distance made good in a given time will be represented by the third side of a triangle, whereof the distance given by the log, and the drift of the current in the same time, are the other sides; and the true course will be the angle contained between the meridian and the line actually described by the ship.

Ex.

Current Sailing.

Ex. 1. A ship sailed NNE at the rate of 8 knots an hour, during 18 hours, in a current setting NW*b*W$2\frac{1}{2}$ miles an hour. Required the course and distance made good?

Plate CCCLXV. Fig. 45.

By Construction.

Draw the NNE line CA (fig. 45.) equal to $18\times 8=144$ miles; and from A draw AB parallel to the NW*b*W rhumb, and equal to $18\times 2\frac{1}{2}=45$ miles: now BC being joined will be the distance, and NCB the course. The first of these will measure 159 miles, and the second 6° 23′.

By Calculation.

In the triangle ACB, are given AC=144 miles, AB=45 miles, and the angle CAB=9 points, to find BAC and BC.

To find the course made good.

Dist. AC -	144	Ang. BAC=9 pts=	101° 15′
Dist. AB -	45		
		B+C	78 45
Sum -	189	B+C	
Diff. -	99	2 -	39 $22\frac{1}{2}$

As the sum of the sides -	189 -	2.27646
is to the difference of the sides	99 -	1.99563
so is the tan. of half sum angles	39 $22\frac{1}{2}$	9.91417
to the tan. of half diff. angles -	23 $15\frac{1}{2}$	9.63334

Angle ACB -	16 7
Angle ACN -	22 30
Course made good	N 6 23

To find the distance.

As the sine of ACB -	16° 7′	-	9.44341
is to the sine of CAB -	101 15	-	9.99157
so is the distance AB -	45	-	1.65321
to the distance CB -	159	-	2.20137

Ex. 2. A ship from a port in latitude 42° 52′ N, sailed S*b*W$\frac{1}{2}$W 17 miles in 7 hours, in a current setting between the north and west; and then the same port bore ENE, and the ship's latitude by observation was 42° 42′ N. Required the setting and drift of the current?

By Construction.

Fig. 46.

Draw the S*b*W$\frac{1}{2}$W line CA (fig. 46.) equal to 17 miles, and make CB equal to 10 miles, the difference of latitude: through B draw the parallel of latitude BD, and draw the WSW line CD, intersecting BD in D: AD being joined, will represent the drift of the current, which applied to the scale will measure 20.2, and the angle DAE will be its setting, and will be found equal to 72°.

By Calculation.

In the triangle CBD, given CB=10 miles, and the angle BCD=6 points; to find the distance CD.

As radius - - - - -			10.00000
is to the secant of BCD -	6 points	-	10.41710
so is the diff. of lat. CB -	10 miles		1.00000
to the distance CD -	26.13	-	1.41710

Again, In the triangle ACD are given the distance AC=17 miles, CD=26.13, and the angle ACD $4\frac{1}{2}$ points; to find the remaining parts.

Current Sailing.

To find the setting of the current.

Distance DC=26.13 Angle ACD=$4\frac{1}{2}$ points.
Distance AC=17. 0 CAD+CDA $11\frac{1}{2}$

Sum - 43.13 $\frac{\text{CAD+CDA}}{2}=5\frac{3}{4}=64\,1^{\text{r}}$,

Difference - 9.13

As the sum of the sides	43.13	-	1.63478
is to the differ. of the sides -	9.13	-	0.96047
so is tang. half sum angles -	64°41′	-	10.32509
to tang. half diff. angles -	24 6	-	9.65078

Angle CAD - -	88 47
Angle CAE = ACB = $1\frac{1}{2}$ p. =	16 62
Setting of the current EAD =	71 55

To find the drift of the current.

As the sine of CAD -	88° 47′	-	9.9999σ
is to the sine of ACD -	$4\frac{1}{2}$ points		9.88819
so is the distance CD -	26.13	-	1.41710
to the drift of current AD	20.2	-	1.30539

Hence the hourly rate of the current is $\frac{20.2}{7}=2.9$ knots.

Ex. 3. A ship, from latitude 38° 20′ N, sailed 24 hours in a current setting NW*b*N, and by account is in latitude 38° 42′ N, having made 44 miles of easting; but the latitude by observation is 38° 58′ N. Required the course and distance made good, and the drift of the current.

By Construction.

Make CE (fig. 47.) equal to 22 miles, the difference Fig. 47. of latitude by D, R, and EA=54 miles, the departure, and join CA; make CD=38 miles, the difference of latitude by observation; draw the parallel of latitude DB, and from A draw the NW*b*N line AB, intersecting DB in B, and AB will be the drift of the current in 24 hours: CB being joined, will be the distance made good, and the angle DCB the true course. Now, AB and CB applied to the scale, will measure 19.2 and 50.5 respectively: and the angle DCB will be $41^{\circ}\frac{1}{4}$.

By Calculation.

From B draw BF perpendicular to AE, then in the triangle AFB are given BF=16 miles, and the angle ABF=3 points; to find AB and AF.

To find the drift of the current AB.

As radius - - -			10.00000
is to the secant of ABF -	3 points	-	10.08015
so is BF - - -	16 miles	-	1.20412
to the drift of the current AB	19.24	-	1.28427

Hence the hourly rate=$\frac{19.24}{24}=0.8$.

To find AF.

As radius - - - - -			10.00000
is to the tangent of ABF -	3 points	-	9.82489
so is BF - - -	16 miles	-	1.20412
to AF - - -	10.69	-	1.02901
Departure by account EA -	44.		
True departure	EF=DB=33.31		

Now,

Current Sailing.

Now, in the triangle CDB are given the difference of latitude and departure; to find the course and distance.

To find the course.

As the difference of latitude CD	38.	1.57978
is to the departure DB	33.31	1.52257
so is radius		10.00000
to the tangent of the course	41° 14′	9.94279

To find the distance.

As radius		10.00000
is to the secant of the course	41° 14′	10.12376
so is the difference of latitude	38	1.57978
to the distance	50.53	1.70354

Ex. 4. In the Straits of Sunda, at 2 P. M. steering SE*b*S at the rate of 5 knots an hour, I passed close by the small islands off Hog point. At 6, not having changed our course, came to anchor on the Java shore. Upon setting the said island from this anchoring place, I find it bears due north, its distance by the chart being 22 miles. It follows from hence, that our course has been affected by a current. Required its velocity and direction?

By Construction.

Fig. 48. From A (fig. 48.) draw the SE*b*S line AB=20, which will represent the ship's apparent track through the water; draw AC equal to 22 miles south, and C will be the ship's real place; and BC being joined will be the current's drift in four hours; which applied to the scale will measure 12.3; from A draw AD parallel to BC, and the angle CAD will be the direction of the current, and will be found to measure $64°\frac{1}{2}$.

By Calculation.

In the triangle ABC, given AB=20 m. AC=22 m. and the included angle A=3 points; to find the remaining parts.

To find the setting of the current.

Distance AC=22 m. Included angle =3 points.

AB=20 B+C=13

Sum	42	$\frac{B+C}{2}$	$=6\frac{1}{2}$p$=73.7\frac{1}{2}$
Difference	2		
As the sum of the sides	42		1.62325
is to the diff. of the sides	2		0.30103
so is the tang. of half sum angles	73° 7′½		10.51806
to tang. of half diff. angles	$8.55\frac{1}{4}$		9.19584

Setting of the current S 64 12W, or SW*b*W¼W.

To find the drift of the current.

As the sine of ACB	64° 12′		9.95440
is to the sine of BAC	33 45		9.74474
so is the distance AB	20		1.30103
to the velocity of cur. BC	12 34		1.09137

and $\frac{12.34}{4}=3.1$, its hourly rate.

Example. 5. A ship bound from Dover to Calais, lying 21 miles to the SE*b*E½E, and the flood tide setting NE½E $2\frac{1}{2}$ miles an hour. Required the course she must steer, and the distance run by the log at 6 knots an hour to reach her port?

Instruments to solve Problems in Sailing without Calculation.

By Construction.

In the position of the SE*b*E½E rhumb, draw DC =21 miles (fig. 49.); draw DE NE½E=$2\frac{1}{2}$ miles; from E with 6 miles cut DC in F; draw DB parallel to EF, meeting CB drawn parallel to DE: then the distance DB applied to the scale will measure 19.4, and the course SDB will be SE½S. Fig. 49.

By Calculation.

In the triangle DBF, given DE=$2\frac{1}{2}$ miles, EF =6 miles and the angle EDF=6 points; to find the angle DFE=CBD.

As the hourly rate of sailing	6m.	0.77815
is to the hourly rate of current	$2\frac{1}{2}$m.	0.39794
so is the sine of EDF=6 point	67° 30′	9.96562
to the sine of DFE	22 38	9.58541
Angle SDC=$5\frac{1}{2}$ points =	61 52	
Course SDB	39 14=SE½S.	

In the triangle DBC, given DC=21 miles, the angle BDC=DFE=22° 38′, and the angle DCB= DEF=6 points; to find the distance DB.

As the sine of DBC	89° 52′		9.99999
is to the sine of DCB	67 30		9.96562
so is the true distance DC	21 m.		1.32222
to the distance by the log DB.	21 m.		1.28785

CHAP. XI. *Instruments proposed to solve the various Problems in Sailing, independent of Calculation.*

VARIOUS methods, besides those already given, have been proposed to save the trouble of calculation.—One of these methods is by means of an instrument composed of rulers, so disposed as to form a right-angled triangle, having numbers in a regular progression marked on their sides. These instruments are made of different materials, such as paper, wood, brass, &c. and are differently constructed, according to the fancy of the inventor. Among instruments of this kind, that by John Cooke, Esq. seems to be the best. A number of other instruments, very differently constructed, have been proposed for the same purpose; of these, however, we shall only take notice of the rectangular instrument, by A. Mackay, LL.D. F.R.S.E. &c.

I. *Of* COOKE's *Triangular Instrument.*

Description. The stock *a b c d* (fig. 50.) is a parallelopiped: The length from *a* to *b* is two feet, the breadth from *a* to *d* two inches, and the depth is one inch and a half. The stock is perforated longitudinally, so as to be capable of containing within it *e f*, a cylindrical piece of wood one inch diameter; *g h* is an aperture on the surface of the stock about a quarter of an inch wide, which discloses one-twelfth part of the surface of the cylinder contained; the edge *d c* is divided into twelve parts, each of these is subdivided into six parts, and each of these again into ten parts. The surface of the cylinder is divided longitudinally into twelve parts, and on each of them is engraved a Fig. 50.

portion

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portion of a line of meridional parts 22 feet long, which contains the meridional parts for every minute from the equator as far towards the pole as navigation is practicable; and the smallest division on it is not less than $\frac{1}{20}$th of an inch. By rolling and sliding this cylinder, any part of any line on it may be brought into any position which may be required; the box *i* is engrooved into the edge of the stock *a b*, so that it may move freely from *a* to *b*; a limb from this box extends to *k*, which serves to mark that degree of the perpendicular *i l* which is parallel to the centre of the semicircle *m*; *i l* is two feet long, and graduated on both edges as the stock; it is perpendicular to the stock, and is fixed in the box *i*, by which it may be moved from *a* to *b*; *o p n* is a semicircle of six inches radius, engraved, as appears in the plate, which slides freely from *c* to *d* in a groove in the edge of the stock *c d*; *m q* is the index moving on the centre *m*, the edge of which marks the course on the semicircle; it is two feet long, and divided into 72 parts; and these are subdivided in the same manner as those on the stock and perpendicular, to which they are equal; *r* is a vernier attached to the index to show minutes; *S* is a vernier composed of concentric semicircles, which slides along the edge *q m*, to the intersection of the perpendicular and index, where it serves as a vernier to both; below *x* is a small piece of ivory, with a mark on it to point out the degree of the line *d c*, which is perpendicularly under the centre of the semicircle. Fig. 51. is a view of the back part of the instrument.

Fig. 51.

Use. The method of working every case which occurs in navigation, is to make the instrument similar to that ideal triangle which is composed of the difference of latitude, departure, and distance; or, to that composed of the meridional difference of latitude, difference of longitude, and enlarged distance; or, to that composed of the difference of longitude, departure, and sine of the middle latitude; which is done by means of the data procured from the compass, log-line, and quadrant: whence it follows, from the nature of similar triangles, or from the relation which exists between the sides of triangles and the sines of their opposite angles, that the parts of the instrument become proportional to those which they represent; and will ascertain the length of the lines, or the extent of the angles sought, by its gradations.

In the practice of this instrument, a small square is necesary in order to bring the centre of the semicircle perpendicularly over the meridional degree corresponding to the latitude.

Plane Sailing.

Prob. I. The course and distance sailed being given, to find the difference of latitude and departure.

Example. A ship from latitude 24° 18′ N, sailed NW*b*N 168 miles. Required the latitude come to, and departure?

Set the centre of the semicircle perpendicularly over the given latitude 24° 18′, and the index to the course 3 points; move the perpendicular until it cut the index at the given distance 168; then at the point of intersection on the perpendicular is 93.3 miles, the departure, and on the base, by the edge of the box, is 26° 38′, the latitude come to.

Prob. II. Both latitudes and course given, to find the distance and departure.

Instruments to solve Problems in Sailing, without Calculation.

Example. Let the latitude sailed from be 43° 50′N, that come to 47° 8′ N, and the course NNE. Required the distance and departure?

Move the centre of the semicirele to the latitude left 43° 50′, and the edge of the box to the latitude come to 47° 8′; fix the index at the given course 2 points: then at the point of intersection of the index and perpendicular is the distance 214 miles on the index, and the departure 82 miles on the perpendicular.

Prob. III. Given the course and departure, to find the distance and difference of latitude.

Example. Let the latitude sailed from be 32° 38′N, the course SW*b*S, and the departure 200 miles. Required the distance and latitude come to?

Move the centre of the semicirele to the latitude left 32° 38′, set the index to the given course 3 points, and move the perpendicular till the given departure 200 cuts the index; at this point on the index is 360 miles, and the edge of the box will cut the latitude come to 27° 39′ N.

Prob. IV. Given the difference of latitude and distance, to find the course and departure.

Example. Let the latitude left be 17° 10′ N, the latitude come to 21° 40′ N, and the distance sailed on a direct course between the north and west 300 miles. Required the course and departure?

Move the semicircle and box to the given latitudes, and the index until the distance found thereon meets the perpendicular; then at the point of contact on the perpendicular is 130.8, the departure, and on the semicircle by the index is 25° 50′, the course.

Prob. V. The distance and departure given, to find the course and difference of latitude.

Example. The distance sailed is 246 miles between the south and east, the departure is 138 miles, and the latitude left 51° 10′ N. Required the course and latitude come to?

Set the centre of the semicircle to 51° 10′, the latitude sailed from; find the distance 246 on the index, and the departure 138 on the perpendicular; then move both till these points meet, and the course 34° 10′ will be found on the semicircle by the index, and the latitude in 47° 47′ N, by the edge of the box.

Prob. VI. Both latitudes and departure given, to find the course and distance.

Example. A ship from latitude 43° 10′ N, sailed between the north and west till she was in latitude 47° 14′ N, and has made 170 miles of departure. Required the course and distance?

Move the centre of the semicirele over 43° 10′, and the edge of the box to 47° 14′; find the departure on the perpendicular, and bring the edge of the index thereto; now at the point of intersection is the distance 297.4 miles on the index, and the course 34° 52′ on the semicirele.

Traverse Sailing.

Example. A ship from latitude 46° 48′ N, sailed SSW$\frac{1}{2}$W 24 miles, S*b*W 36 miles, and S$\frac{1}{2}$E 40 miles.

Instruments to solve Problems in Sailing, without Calculation.

miles. Required the latitude in, together with the direct course and distance?

Set the semicircle to the latitude sailed from 46° 48′, and the index to the course SSW½W; mark the distance 24 on the index, and bring the perpendicular to meet it; then the index will cut the departure 11.3 on the perpendicular, and the perpendicular will cut the latitude 46° 27′ N on the base. For the next course and distance, bring the semicircle to the latitude marked by the perpendicular, and lay down the course S8W: if it be towards the first meridian, move the last marked departure until it meets the index, and the limb of the box will mark the present departure; but if the course be from the first meridian, bring the last departure 11.3 to the limb of the box, the index will mark the departure made good 18.3 on the perpendicular, and the latitude arrived at 40° 52′ will be marked on the base by the perpendicular: proceed in the same manner with all the courses of which the traverse consists, then the difference of latitude 1° 36′ will be intercepted between the latitude sailed from 46° 48′, and the latitude come to 45° 12′ last marked by the perpendicular; and also the departure made good will be intercepted between that point on the perpendicular where the first departure commenced, and that where the last terminated. Now, with the difference of latitude 1° 36′ and the departure, the course will be S 8° 30′ W, and distance 97 miles, by last problem in Plane Sailing.

Parallel Sailing.

Prob. I. The difference of longitude between two places in one parallel of latitude given, to find the distance between them.

Example. Let the common latitude be 49° 30′ N, and the difference of longitude 3° 30′. Required the distance?

Set the index to 40° 30′, the complement of the latitude on the semicircle; mark the difference of longitude in miles on the index; then move the perpendicular until it meets the termination of the difference of longitude on the index, and the part of the perpendicular intercepted between the limb of the box and the point of intersection will be the distance 136.4 miles.

Prob. II. The distance between two places in one parallel of latitude given, to find the difference of longitude between them.

Example. Let the latitude of the given parallel be 49° 30′ N, the distance sailed 136.4 E. Required the difference of longitude?

Set the index to the complement of the latitude 40° 30′, and mark the distance sailed on the perpendicular; then move it until it meets the index, and the point of intersection will show the difference of longitude 210′ or 3° 30′ on the index.

Prob. III. Given the distance sailed on a parallel, and the difference of longitude, to find the latitude of that parallel.

Example. The distance sailed due east is 136.4, and the difference of longitude 3° 30′. Required the latitude of the parallel?

Find the difference of longitude 210 on the index, and the distance 136.4 on the perpendicular, and move both until these numbers meet, and the complement of the latitude 4° 30′ will be shown by the index on the semicircle.

Instruments to solve Problems in Sailing without Calculation.

Mercator's and Middle Latitude Sailing.

Prob. I. The latitudes and longitudes of two places given, to find the direct course and distance between them.

Example. Required the course and distance between two places whose latitudes and longitudes are 50° 30′ N, 19° 0′ W, and 54° 30′ N, 15° 30′ W, respectively?

By Mercator's Sailing.

To find the course.

Move the centre of the semicircle perpendicularly over the meridional degree answering to latitude 56° 50′ N, then move the box until the edge of the perpendicular cuts the meridional parts of the other latitude 54° 30′ N, and move the index until it cuts the difference of longitude 3° 30′ on the perpendicular, and the index will mark the course 30° 10′, or NNE¾E nearly on the semicircle.

To find the distance.

Screw the index to this course, and move the centre of the semicircle to the latitude 50° 50′ N, and the edge of the perpendicular to the latitude 54° 30′ N, then the perpendicular will cut the distance 254.7 on the index.

By Middle Latitude Sailing.

To find the departure.

Move the centre of the semicircle to the latitude 50° 50′, and the edge of the index to the complement of the middle latitude 37° 20′ on the semicircle; then move the box until the edge of the perpendicular intersects the termination of the difference of longitude 210 miles on the index, which point of intersection will mark the departure 128 on the perpendicular.

To find the course and distance.

Move the edge of the perpendicular to the other latitude 54° 30′, and the index until it cuts the departure 128 on the perpendicular; then will the perpendicular mark the distance on the index 254.7 miles, and the index will mark the course on the semicircle 30° 10′, or NNE¾E nearly.

Prob. II. Both latitudes and course given, to find the distance and difference of longitude.

Example. A ship from latitude 50° 50′ N, longitude 19° 0′ W, sailed N 30° 10′ E, until she is in latitude 54° 30′ N. Required the distance and difference of longitude?

By Mercator's Sailing.

To find the difference of longitude.

Move the box and semicircle as in the former problem to the meridional parts of the given latitudes, then set the index to the course, and it will mark the difference of longitude 3° 30′ on the perpendicular: Hence the longitude in is 15° 30′ W.

To find the distance.

Move the perpendicular and semicircle to the given latitudes, and put the index to the given course; then the perpendicular will cut the distance 254.7 miles on the index.

By

Instruments to solve Problems in Sailing, without Calculation.

By Middle Latitude Sailing.

To find the distance and departure.

Move the semicircle and perpendicular to the given latitudes, and the index to the course; then the perpendicular will show the departure 128 miles, and the index the distance 254.7 miles at the point of intersection.

To find the difference of longitude.

Set the index to the complement of the middle latitude on the semicircle, and move the box until the termination of the departure on the perpendicular meets the index, which will mark the difference of longitude thereon 210 m. or 3° 30′.

PROB. III. Both latitudes and distance given, to find the course and difference of longitude.

Example. From latitude 50° 50′ N, longitude 19° 0′ W, a ship sailed 254.7 miles between the north and east, and by observation is in latitude 54° 30′ N. Required the course and difference of longitude?

By Mercator's Sailing.

To find the course.

Move the perpendicular and semicircle to the given latitudes, and the index until the distance sailed marked on it meets the perpendicular; then the index will mark the course N 30° 10′ E on the semicircle.

To find the difference of longitude.

Screw the index to the course, move the perpendicular and semicircle to the meridional parts of the given latitudes, and the space intercepted between the limb of the box and the index will be the difference of longitude 3° 30′.

By Middle Latitude Sailing.

To find the departure and course.

Move the semicircle and perpendicular to the given latitudes, and the index until the distance sailed on it cuts the perpendicular; then the perpendicular will show the departure 128 miles, and the semicircle the course N 30° 10′ E.

To find the difference of longitude.

Set the index to 37° 20′, the complement of the middle latitude on the semicircle, and move the perpendicular until the termination of the departure on it cuts the index: then the point of intersection will mark the difference of longitude 210 miles on the index.

PROB. IV. Both latitudes and departure given, to find the course, distance, and difference of longitude.

Example. Let the latitude and longitude sailed from be 56° 40′ S and 28° 55′ E respectively, the latitude come to 61° 20′ S, and departure 172 miles. Required the course, distance, and difference of longitude?

By Mercator's Sailing.

To find the course and distance.

Move the perpendicular and semicircle to the given latitude (H); then move the index till it meets the extremity of the departure on the perpendicular; the distance will be marked on the index 329, and the course S 31° 35′ E, or SSE¾E nearly, on the semicircle.

Instruments to solve Problems in Sailing, without Calculation.

To find the difference of longitude.

Move the perpendicular and semicircle to the meridional parts of the given latitudes, and the index will cut the difference of longitude on the perpendicular 5° 35′.

By Middle Latitude Sailing.

The course and distance are found as before.

To find the difference of longitude.

Set the index to 31°, the complement of the middle latitude on the semicircle, and move the perpendicular until the departure marked on it cuts the index, and this point of intersection will mark the difference of longitude on the index 335 m. or 5° 35′.

PROB. V. One latitude, course, and distance given, to find the difference of latitude and difference of longitude.

Example. Let the latitude left be 56° 40′ S, longitude 28° 55′ E, the course S 31° 35′ E, and distance 329 m. Required the latitude and longitude come to?

By Mercator's Sailing.

To find the latitude come to.

Set the semicircle to the latitude sailed from, and the index to the course, and bring the perpendicular to the distance, which at the same time will mark the latitude come to 61° 20′ S.

To find the difference of longitude.

Screw the index to the course, and move the semicircle and perpendicular to the meridional parts of both latitudes; then the index will cut the difference of longitude on the perpendicular 5° 35′.

By Middle Latitude Sailing.

The latitude arrived at is found as above.

To find the departure.

The semicircle and perpendicular being set to both latitudes, and the index to the course, it will show the departure 172.7 on the perpendicular.

To find the difference of longitude.

Set the index to 31° the complement of the middle latitude on the semicircle, and move the perpendicular until the departure marked on it cuts the index, and the division on the index at the point of intersection will be the difference of longitude 335.

PROB. VI. One latitude, course, and departure given, to find the distance, difference of latitude, and difference of longitude.

Example. Let the latitude sailed from be 56° 40′ N, longitude 28° 35′ W, the course N 31° 35′ W, and departure 172.7. Required the distance, and the latitude and longitude come to?

By Mercator's Sailing.

To find the distance and latitude come to.

Move the semicircle to the latitude left, and the index to the course; mark the departure on the perpendicular,

(H) In southern latitudes, the end of the cylinder where the numbers begin must be turned towards the north pointed out by the semicircle; and in northern latitudes, it must be reversed.

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dicular, and move it until the termination thereof meets the index, then the point of intersection will show the distance 329 miles on the index, and the perpendicular will show the latitude arrived at 61° 20′ N on the base.

To find the difference of longitude.

Screw the index, and move the perpendicular and semicircle to the meridional parts of both latitudes, then the index will cut the difference of longitude 5° 35′ on the perpendicular.

By Middle Latitude Sailing.

Find the distance sailed and latitude in as above, and the difference of longitude as in Problem IV. by middle latitude sailing.

Prob. VII. One latitude, the distance sailed, and departure given, to find the course, difference of latitude, and difference of longitude.

Example. The latitude sailed from is 48° 30′ N, and longitude 14° 40′ W; the distance run is 345 miles between the south and east, and the departure 200 miles. Required the course, and the latitude and longitude come to?

By Mercator's Sailing.

To find the course and latitude come to.

Move the semicircle to the latitude left, mark the distance on the index, and the departure on the perpendicular, move both until these points meet; then will the index show the course S 35° 26′ E on the semicircle, and the latitude come to 43° 49′ on the base.

The difference of longitude is found as in the preceding problem.

By Middle Latitude Sailing.

The course and latitude come to are found as above, and the difference of longitude as in Problem IV. by middle latitude sailing.

II. *Of* Dr Mackay's *Rectangular Instrument.*

Plate CCCLXVI Fig. 52.

Description. Fig. 52. is a representation of this instrument, of about one-third of the original size.—The length CA is divided into 100 equal parts, and the breadth CB into 70; but in this plate every second division only is marked, in order to avoid confusion; through these divisions parallels are drawn, terminating at the opposite sides of the instrument. Upon the upper and right hand sides are two scales; the first contains the degrees of the quadrant, and the other the points and quarters of the compass. M is an index moveable about the centre C, and divided in the same manner as the sides (1). Fig. 53. is a portion of the enlarged meridian, so constructed that the first degree is equal to three divisions on the instrument; and therefore, in the use of this line, each division on the instrument is to be accounted 20 minutes. The size of the plate would not admit of the continuation of the line.

Use. From a bare inspection of this instrument, it is evident that any triangle whatever may be formed on it. In applying it to nautical problems, the course is to be found at top, or right-hand side, in the column of degrees or points, according as it is expressed; the distance is to be found on the index, the difference of latitude at either side column, and the departure at the head or foot of the instrument. The numbers in these columns may represent miles, leagues, &c.; but when used in conjunction with the enlarged meridional line, then 10 is to be accounted 100 miles, 20 is to be esteemed 200 miles, and so on, each number being increased in a tenfold ratio; and the intermediate numbers are to be reckoned accordingly.

Instruments to solve Problems in Sailing, without Calculation.

Plane Sailing.

Prob. I. The course and distance sailed given, to find the difference of latitude and departure.

Example. Let the course be NE½N, distance 44 miles. Required the difference of latitude and departure?

Move the index until the graduated edge be over 3½ points, and find the given distance 44 miles on the index: this distance will be found to cut the parallel of 34 miles, the difference of latitude in the side column, and that of 28 miles, the departure at the top.

Prob. II. Given the course and difference of latitude, to find the distance and departure.

Example. Required the distance and departure answering to the course 28°, and difference of latitude 60 miles?

Lay the index over the given course 28°: find the difference of latitude 60 miles in the side column; its parallel will cut the index at 68 miles, the distance and the corresponding departure at the top is 32 miles.

Prob. III. The course and departure given, to find the distance and difference of latitude.

Example. Let the course be SSW and the departure 36 miles. Required the distance and difference of latitude?

Lay the index over two points; find the departure at the top, and its parallel will cut the index at 94 miles the distance, and the difference of latitude on the side column is 87 miles.

Prob. IV. Given the distance and difference of latitude, to find the course and departure.

Example. The distance is 35 leagues, and the difference of latitude 30 leagues. Required the course and departure?

Bring 35 leagues on the index to the parallel of 30 leagues in the side; then the departure at the top is 18 leagues, and the course by the edge of the index on the line of rhumbs is 2¾ points.

Prob. V. Given the distance and departure, to find the course and difference of latitude.

Example. Let the distance be 58 miles, and the departure

(1) In the original instrument are two slips, divided like the side and end of the instrument. One of these slips is moveable in a direction parallel to the side of the instrument, and the other parallel to the end.

Instruments to solve Problems in Sailing, without Calculation.

parture 15 miles. Required the course and difference of latitude?

Move the index until 58 found thereon cuts the parallel of 15 from the top: this will be found to intersect the parallel of 56 miles, the difference of latitude; and the course by the edge of the ruler is 15°.

PROB. VI. The difference of latitude and departure being given, to find the course and distance.

Example. Let the difference of latitude be 30 miles, the departure 28 miles. Required the course and distance?

Bring the index to the intersection of the parallels of 30 and 28; then the distance on the index is 41 miles, and the course by its edge is 43°.

Traverse Sailing.

Find the difference of latitude and departure answering to each course and distance by Problem I. of Plane Sailing, and from thence find the difference of latitude and departure made good; with which find the course and distance by the last problem.

An example is unnecessary.

Parallel Sailing.

PROB. I. Given the difference of longitude between two places on the same parallel, to find the distance between them.

Example. Let the latitude of a parallel be 48°, and the difference of longitude between two places on it 3° 40′. Required their distance?

Put the index to 48°, the given latitude, and find the difference of longitude 220 on the index, and the corresponding parallel from the side will be 147, the distance required.

PROB. II. The latitude of a parallel, and the distance between two places on that parallel, being given, to find the difference of longitude between them.

Example. The latitude of a parallel is 56°, and the distance between two places on it 200 miles. Required their difference of longitude?

Put the index to the given latitude, and find the distance in the side column, and the intersection of its parallel with the index will give 358, the difference of longitude sought.

PROB. III. Given the distance and difference of longitude between two places on the same parallel, to find the latitude of that parallel.

Example. The number of miles in a degree of longitude is 46.5. Required the latitude of the parallel?

Bring 60 on the index to cut the parallel of 46.5 from the side, then the edge of the index will give 39° 11′, the latitude required.

Middle Latitude and Mercator's Sailing.

PROB. I. The latitudes and longitudes of two places being given, to find the course and distance between them.

Example. Required the course and distance between Genoa, in latitude 44° 25′ N, longitude 8° 36′ E, and Palermo, in latitude 38° 10′ N, longitude 13° 38′ E?

By Mercator's Sailing.

Take the interval between 38° 10′ and 44° 25′ on the enlarged meridian, which laid off from C upwards will reach to 500; now find the difference of longitude 302 at the top, and bring the divided edge of the index to the intersection of the corresponding parallels, and the index will show the course 31° 8′ on the line of degrees; then find the difference of the latitude 375 on the side column, and its parallel will intersect the index at 438, the distance.

Instruments to solve Problems in Sailing without Calculation.

By Middle Latitude Sailing.

Put the index to 41° 18′, the complement of the middle latitude on degrees, and the difference of longitude 302 on the index will intersect the parallel of 227, the departure, in the side column. Now move the index to the intersection of the parallels of 375 and 227, the first being found in the side column, and the other at top or bottom; then the distance answering thereto on the index will be 438, and the course on the scale of degrees is 41° 10′.

PROB. II. Given one latitude, course, and distance, to find the other latitude and difference of longitude.

Example. Let the latitude and longitude sailed from be 39° 22′ N, and 12° 8′ W respectively, the course NNW½W, and distance 500 miles. Required the latitude and longitude come to?

By Mercator's Sailing.

Put the index to the course 2½ points, and find the distance 500 miles thereon; then the corresponding difference of latitude will be 441 miles, and the departure 235¼ miles, hence the latitude in is 46° 43′ N. Now take the interval between the latitudes of 39° 22′, and 46° 43′ on the enlarged meridian, which laid off from C will reach to about 605, the parallel of which will intersect the vertical parallel of the difference of longitude 323 at the edge of the index: hence the longitude in is 17° 31′ W.

By Middle Latitude Sailing.

Find the difference of latitude and departure as before, and hence the latitude in is 46° 43′ N, and the middle latitude 43° 3′. Now put the index to 43° 3′, and the horizontal parallel of the departure 235½ will intersect the index at 322, the difference of longitude.

PROB. III. Both latitudes and course given, to find the distance and difference of longitude.

Example. The latitude sailed from is 22° 54′ S, and longitude 42° 40′ W, the course is SE by E, and latitude come to 26° 8′ S. Required the distance sailed, and longitude in?

By Mercator's Sailing.

Bring the index to 5 points, the given course, and the parallel of 194, the difference of latitude found in the side column, will intersect the index at 349, the distance; and it will cut the vertical parallel of 290, the departure

Take the interval between the given latitudes 22° 54′ and 26° 8′ on the enlarged meridian; lay off that extent from the centre on the side column, and it will reach to 213: the parallel of this number will intersect the vertical parallel of 319, the difference of longitude. Hence the longitude in is 37° 21′ W.

By

Instruments to solve Problems in Sailing, without Calculation.

By Middle Latitude Sailing.

With the given course and difference of latitude find the distance and departure as before; then bring the index to the middle latitude 24° 31′; find the departure 290 in the side column, and its parallel will intersect the index at 319, the difference of longitude.

PROB. IV. One latitude, course, and departure, given, to find the other latitude, distance, and difference of longitude.

Example. The latitude and longitude left are 20° 30′ N, and 49° 17′ W, respectively; the course is NE$\frac{3}{4}$N, and departure 212 miles. Required the latitude and longitude come to, and distance sailed?

By Mercator's Sailing.

Put the index to the given course 3$\frac{1}{4}$ points, and the vertical parallel of 212 will cut the index at 356, the distance, and the horizontal parallel of 286, the difference of latitude; the latitude come to is therefore 25° 16′ N.

Now take the interval between the latitudes 20° 30′, and 25° 16′ on the enlarged meridian, which laid off from the centre C will reach to 311; and this parallel will intersect the vertical parallel of the difference of longitude 230, at the edge of the index. Hence the longitude in is 45° 27′ W.

By Middle Latitude Sailing.

Find the distance and difference of latitude as directed above; then bring the index to 22° 53′, the middle latitude, and the horizontal parallel of 212, the departure, will intersect the index at 230, the difference of longitude.

PROB. V. Both latitudes and distance given, to find the course and difference of longitude.

Example. The distance sailed is 500 miles between the north and west; the latitude and longitude left are 40° 10′ N, and 9° 20′ W respectively, and the latitude in is 46° 40′ N. Required the course and longitude in?

By Mercator's Sailing.

Bring the distance 500 on the index to intersect the horizontal parallel of the difference of latitude 390; then the course 38° 44′ is found on the line of degrees by the edge of the index, and the vertical parallel of the above point of intersection is that answering to 313, the departure.

Take the interval between the latitudes 40° 10′, and 46° 40′, which lay off from the centre C, and its horizontal parallel will intersect the vertical parallel of 431, the difference of longitude, by the edge of the index, it being in the same position as before. Hence the longitude in is 16° 31′ W.

By Middle Latitude Sailing.

The course and departure are found as formerly, and the middle latitude is 43° 25′, to which bring the edge of the index, and the horizontal parallel of 313, the departure, will intersect the index at 431, the difference of longitude.

PROB. VI. Both latitudes and departure given, to find the course, distance, and difference of longitude.

Example. Let the latitude sailed from be 42° 52′ N, long. 9° 17′ W, the departure 250 miles W, and the latitude come to 36° 18′ N. Required the course and distance sailed, and the longitude come to?

Sea Charts

By Mercator's Sailing.

Find the point of intersection of the horizontal parallel of 394, the difference of latitude, and the vertical parallel of 250, the departure; to this point bring the index, and the corresponding division thereon will be 467 miles, and the course on the scale of degrees by the edge of the index will be 32° 24′.

Take the interval between the latitudes on the enlarged meridian; which being laid off from the centre will reach to 512: now the horizontal parallel of 512 will cut the vertical parallel of 325, the difference of longitude, at the edge of the index. The longitude come to is therefore 14° 42′ W.

By Middle Latitude Sailing.

The course and distance are to be found in the same manner as above. Then bring the index to 39° 35′, the middle latitude, and the horizontal parallel of 250 will intersect the edge of the index at 324$\frac{1}{2}$, the difference of longitude.

PROB. VII. Given one latitude, distance, and departure, to find the other latitude, course, and difference of longitude.

Example. A ship from latitude 32° 38′ N, longitude 17° 6′ W, sailed 586 miles between the south and west, and made 336 miles of departure:—Required the course, and the latitude and longitude come to?

By Mercator's Sailing.

Move the index till the distance 586 intersects the vertical parallel of the departure 336; then the corresponding horizontal parallel will be 480, the difference of latitude, and the course 35°. Hence the latitude in is 24° 38′ N.

Now take the interval between the latitudes on the enlarged meridian, which laid off from the centre will reach to 547, the horizontal parallel of which will cut the vertical parallel of 383, the difference of longitude. The longitude in is therefore 23° 29′ W.

By Middle Latitude Sailing.

Find the course and difference of latitude as before, and hence the middle latitude is 28° 38′, to which bring the index, and the horizontal parallel of 336, the departure, will intersect the index at 383, the difference of longitude.

It seems unnecessary to enlarge any further on the use of this instrument, as the above will make it sufficiently understood.

CHAP. XII. *Of Sea-Charts.*

THE charts usually employed in the practice of navigation, are of two kinds, namely, *Plane* and *Mercator's Charts*. The first of these is adapted to represent a portion of the earth's surface near the equator; and the last for all portions of the earth's surface. For a particular description of these, reference has already been made from the article CHART, to those of PLANE and MERCATOR: and as these charts are particularly described under the above articles, it is therefore sufficient in this place to describe their use.

Use

Sea-Charts.

Use of the Plane Chart.

PROB. I. To find the latitude of a place on the chart.

RULE. Take the least distance between the given place and the nearest parallel of latitude; now this distance applied the same way on the graduated meridian, from the extremity of the parallel, will give the latitude of the proposed place.

Thus the distance between Bonavista and the parallel of 15 degrees, being laid from that parallel upon the graduated meridian, will reach to 16° 5′, the latitude required.

PROB. II. To find the course and distance between two given places on the chart.

RULE. Lay a ruler over the given places, and take the nearest distance between the centre of any of the compasses on the chart and the edge of the ruler; move this extent along, so as one point of the compass may touch the edge of the rule, and the straight line joining their points may be perpendicular thereto; then will the other point show the course: The interval between the places, being applied to the scale, will give the required distance.

Thus the course from Palma to St Vincent will be found to be about SSW¾W, and the distance 13°¼ or 795 m.

PROB. III. The course and distance sailed from a known place being given, to find the ship's place on the chart.

RULE. Lay a ruler over the place sailed from, parallel to the rhumb, expressing the given course; take the distance from the scale, and lay it off from the given place by the edge of the ruler; and it will give the point representing the ship's present place.

Thus, suppose a ship had sailed SW*b*W 160 miles from Cape Palmas; then by proceeding as above, it will be found that she is in latitude 2° 57′ N.

The various other problems that may be resolved by means of this chart require no further explanation, being only the construction of the remaining problems in Plane Sailing on the chart.

Use of Mercator's Chart.

The method of finding the latitude and longitude of a place, and the course of bearing between two given places by this chart, is performed exactly in the manner as in the Plane Chart, which see.

PROB. I. To find the distance between two given places on the chart.

CASE I. When the given places are under the same meridian.

RULE. The difference or sum of their latitudes, according as they are on the same or on opposite sides of the equator, will be the distance required.

CASE II. When the given places are under the same parallel.

RULE. If that parallel be the equator, the difference or sum of their longitudes is the distance; otherwise, take half the interval between the places, lay it off upwards and downwards on the meridian from the given parallel, and the intercepted degrees will be the distance between the places.

Or, take an equal extent of a few degrees from the meridian on each side of the parallel, and the number of extents, and parts of an extent, contained between the places, being multiplied by the length of an extent, will give the required distance.

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CASE III. When the given places differ both in latitude and longitude.

RULE. Find the difference of latitude between the given places, and take it from the equator or graduated parallel; then lay a ruler over the two places, and move one point of the compass along the edge of the ruler until the other point just touches a parallel; then the distance between the place where the point of the compass rested by the edge of the ruler, and the point of intersection of the ruler and parallel, being applied to the equator, will give the distance between the places in degrees and parts of a degree, which multiplied by 60 will reduce it to miles.

PROB. II. Given the latitude and longitude in, to find the ship's place on the chart.

RULE. Lay a ruler over the given latitude, and lay off the given longitude from the first meridian by the edge of the ruler, and the ship's present place will be obtained.

PROB. III. Given the course sailed from a known place, and the latitude in, to find the ship's present place on the chart.

RULE. Lay a ruler over the place sailed from, in the direction of the given course, and its intersection with the parallel of latitude arrived at will be the ship's present place.

PROB. IV. Given the latitude of the place left and the course and distance sailed, to find the ship's present place on the chart.

RULE. The ruler being laid over the place sailed from, and in the direction of the given course, take the distance sailed from the equator, put one point of the compass at the intersection of any parallel with the ruler, and the other point of the compass will reach to a certain place by the edge of the ruler. Now this point remaining in the same position, draw in the other point of the compass until it just touch the above parallel when sweeped round: apply this extent to the equator, and it will give the difference of latitude. Hence the latitude in will be known, and the intersection of the corresponding parallel with the edge of the ruler will be the ship's present place.

The other problems of Mercator's Sailing may be very easily resolved by this chart; but as they are of less use than those given, they are, therefore, omitted, and may serve as an exercise to the student.

BOOK II.

Containing the method of finding the Latitude and Longitude of a Ship at Sea, and the Variation of the the Compass.

CHAP. I. *Of Hadley's Quadrant.*

HADLEY'S quadrant is the chief instrument in use at present for observing altitudes at sea. The form of this instrument, according to the present mode of construction.

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construction, is an octagonal sector of a circle, and therefore contains 45 degrees; but because of the double reflection, the limb is divided into 90 degrees. See ASTRONOMY and QUADRANT. Fig. 54. represents a quadrant of the common construction, of which the following are the principal parts.

Plate CCCLXVII Fig. 54.

1. ABC, the frame of the quadrant.
2. BC, the arch or limb.
3. D, the index; *a b*, the subdividing scale.
4. E, the index-glass.
5. F, the fore horizon-glass.
6. G, the back horizon-glass.
7. K, the coloured or dark glasses.
8. HI, the vanes or sights.

Of the Frame of the Quadrant.

The frame of the quadrant consists of an arch BC, firmly attached to the two radii AB, AC, which are bound together by the braces LM, in order to strengthen it, and prevent it from warping.

Of the Index D.

The index is a flat bar of brass, and turns on the centre of the octant: at the lower end of the index there is an oblong opening; to one side of this opening the vernier scale is fixed, to subdivide the divisions of the arch; at the end of the index there is a piece of brass, which bends under the arch, carrying a spring to make the subdividing scale lie close to the divisions. It is also furnished with a screw to fix the index in any desired position. The best instruments have an adjusting screw fitted to the index, that it may be moved more slowly, and with greater regularity and accuracy, than by the hand. It is proper, however, to observe, that the index must be previously fixed near its right position by the above-mentioned screw.

Of the Index Glass E.

Upon the index, and near its axis of motion, is fixed a plane speculum, or mirror of glass quicksilvered. It is set in a brass frame, and is placed so that its face is perpendicular to the plane of the instrument. This mirror being fixed to the index moves along with it, and has its direction changed by the motion thereof; and the intention of this glass is to receive the image of the sun, or any other object, and reflect it upon either of the two horizon-glasses, according to the nature of the observation.

The brass frame with the glass is fixed to the index by the screw *c*; the other screw serves to re-place it in a perpendicular position, if by any accident it has been deranged.

Of the Horizon-Glasses F, G.

On the radius AB of the octant are two small speculums: the surface of the upper one is parallel to the index-glass, and that of the lower one perpendicular thereto, when *o* on the index coincides with *o* on the limb. These mirrors receive the reflected rays, and transmit them to the observer.

The horizon-glasses are not entirely quicksilvered; the upper one F is only silvered on its lower half, or that next the plane of the quadrant, the other half being left transparent, and the back part of the frame cut away, that nothing may impede the sight through the unsilvered part of the glass. The edge of the foil of this glass is nearly parallel to the plane of the instrument, and ought to be very sharp, and without a flaw. The other horizon-glass is silvered at both ends. In the middle there is a transparent slit through which the horizon may be seen.

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Each of these glasses is set in a brass frame, to which there is an axis passing through the wood work, and is fitted to a lever on the under side of the quadrant, by which the glass may be turned a few degrees on its axis, in order to set it parallel to the index-glass. The lever has a contrivance to turn it slowly, and a button to fix it. To set the glasses perpendicular to the plane of the instrument, there are two sunk screws, one before and one behind each glass: these screws pass through the plate on which the frame is fixed into another plate; so that by loosening one and tightening the other of these screws, the direction of the frame with its mirror may be altered, and set perpendicular to the plane of the instrument.

Of the Coloured Glasses K.

There are usually three coloured glasses, two of which are tinged red and the other green. They are used to prevent the solar rays from hurting the eye at the time of observation. These glasses are set in a frame, which turns on a centre, so that they may be used separately or together as the brightness of the sun may require. The green glass is particularly useful in observations of the moon; it may be also used in observations of the sun, if that object be very faint. In the fore-observation, these glasses are fixed as in fig. 54.; but when the back observation is used, they are removed to N.

Of the two Sight Vanes, H, I.

Each of these vanes is a perforated piece of brass, designed to direct the sight parallel to the plane of the quadrant. That which is fixed at I is used for the fore, and the other for the back, observation. The vane I has two holes, one exactly at the height of the silvered part of the horizon-glass, the other a little higher, to direct the sight to the middle of the transparent part of the mirror.

Of the divisions on the Limb of the Quadrant.

The limb of the quadrant is divided from right to left into 90 primary divisions, which are to be considered as degrees, and each degree is subdivided into three equal parts, which are therefore of 20 minutes each: the intermediate minutes are obtained by means of the scale of divisions at the end of the index.

Of the Vernier, or Subdividing Scale.

The dividing scale contains a space equal to 21 divisions of the limb, and is divided into 20 equal parts. Hence the difference between a division on the dividing scale and a division on the limb is one-twentieth of a division on the limb, or one minute. The degree and minute pointed out by the dividing scale may be easily found thus.

Observe what minute on the dividing scale coincides with a division on the limb: this division being added to the degree and part of a degree on the limb, immediately

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diately preceding the first division on the dividing scale, will be the degree and minute required.

Thus suppose the fourteenth minute on the dividing scale coincided with a division on the limb, and that the preceding division on the limb to *o* on the vernier was 56° 40′; hence the division shown by the vernier is 56° 54′. A magnifying glass will assist the observer to read off the coinciding divisions with more accuracy.

Adjustments of Hadley's Quadrant.

The adjustments of the quadrant consist in placing the mirrors perpendicular to the plane of the instrument. The fore horizon-glass must be set parallel to the speculum, and the planes of the speculum and back horizon-glass produced must be perpendicular to each other when the index is at *o*.

Adjustment I. To set the index-glass perpendicular to the plane of the quadrant.

Fig. 55. and 56.

Method 1. Set the index towards the middle of the limb, and hold the quadrant so that its plane may be nearly parallel to the horizon: then look into the index-glass; and if the portion of the limb seen by reflection appears in the same plane with that seen directly, the speculum is perpendicular to the plane of the instrument. If they do not appear in the same plane, the error is to be rectified by altering the position of the screws behind the frame of the glass.

Method 2. This is performed by means of the two adjusting tools, fig. 55, 56, which are two wooden frames, having two lines on each, exactly at the same distance from the bottom.

Place the quadrant in a horizontal position on a table; put the index about the middle of the arch; turn back the dark glasses; place one of the above-mentioned tools near one end of the arch, and the other at the opposite end, the side with the lines being towards the index-glass; then look into the index-glass, directing the sight parallel to the plane of the instrument, and one of the tools will be seen by direct vision, and the other by reflection. By moving the index a little, they may be brought exactly together. If the lines coincide, the position of the mirror is right; if not, they must be made to coincide by altering the screws behind the frame, as before.

Adjustment II. To set the fore horizon-glass perpendicular to the plane of the instrument.

Set the index to *o*; hold the plane of the quadrant parallel to the horizon; direct the sight to the horizon, and if the horizons seen directly and by reflection are apparently in the same straight line, the fore horizon-glass is perpendicular to the plane of the instrument; if not, one of the horizons will appear higher than the other. Now if the horizon seen by reflection is higher than that seen directly, release the nearest screw in the pedestal of the glass, and screw up that on the farther side, till the direct and reflected horizons appear to make one continued straight line. But if the reflected horizon is lower than that seen directly, unscrew the farthest, and screw up the nearest screw till the coincidence of the horizons is perfect, observing to leave both screws equally tight, and the fore horizon-glass will be perpendicular to the plane of the quadrant.

Adjustment III. To set the fore horizon-glass parallel to the index-glass, the index being at *o*.

Set *o* on the index exactly to *o* on the limb, and fix it in that position by the screw at the under side; hold the plane of the quadrant in a vertical position, and direct the sight to a well-defined part of the horizon; then if the horizon seen in the silvered part coincides with that seen through the transparent part, the horizon-glass is adjusted; but if the horizons do not coincide, unscrew the milled screw in the middle of the lever on the other side of the quadrant, and turn the nut at the end of the lever until both horizons coincide, and fix the lever in this position by tightening the milled screw.

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As the position of the glass is liable to be altered by fixing the lever, it will therefore be necessary to re-examine it, and if the horizons do not coincide, it will be necessary either to repeat the adjustment, or rather to find the error of adjustment, or, as it is usually called, the *index-error*; which may be done thus:

Direct the sight to the horizon, and move the index until the reflected horizon coincides with that seen directly; then the difference between *o* on the limb and *o* on the vernier is the index error; which is additive when the beginning of the vernier is to the right of *o* on the limb, otherwise subtractive.

Adjustment IV. To set the back horizon-glass perpendicular to the plane of the instrument.

Put the index to *o*; hold the plane of the quadrant parallel to the horizon, and direct the sight to the horizon through the back sight vane. Now if the reflected horizon is in the same straight line with that seen through the transparent part, the glass is perpendicular to the plane of the instrument. If the horizons do not unite, turn the sunk screws in the pedestal of the glass until they are apparently in the same straight line.

Adjustment V. To set the back horizon-glass perpendicular to the plane of the index-glass produced, the index being at *o*.

Let the index be put as much to the right of *o* as twice the dip of the horizon amounts to; hold the quadrant in a vertical position, and apply the eye to the back vane; then if the reflected horizon coincides with that seen directly, the glass is adjusted; if they do not coincide, the screw in the middle of the lever on the other side of the quadrant must be released, and the nut at its extremity turned till both horizons coincide. It may be observed, that the reflected horizon will be inverted; that is, the sea will be apparently uppermost and the sky lowermost.

As this method of adjustment is esteemed troublesome, and is often found to be very difficult to perform at sea, various contrivances have therefore been proposed to render this adjustment more simple. Some of these are the following.

1. Mr Dollond's method of adjusting the back horizon-glass.

In this method an index is applied to the back horizon-glass, by which it may be moved so as to be parallel to the index-glass, when *o* on the vernier coincides with *o* on the limb. When this is effected, the index of the back horizon-glass is to be moved exactly 90° from its former position, which is known by means of a divided arch for that purpose; and then the plane of the back horizon-glass will be perpendicular to the plane of the index-glass produced.

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2. Mr Blair's method of adjusting the back horizon-glass.

All that is required in this method is to polish the lower edge of the index-glass, and expose it to view. The back horizon-glass is adjusted by means of a reflection from this polished edge, in the very same method as the fore horizon-glass is adjusted by the common method.

Fig. 57. In order to illustrate this, let RIHE (fig. 57.) represent a pencil of rays emitted from the object R, incident on the index-glass I, from which it is reflected to the fore horizon-glass H, and thence to the eye at E. By this double reflection, an image of the object is formed at *r*. RHE represents another pencil from the same object R, coming directly through the fore horizon-glass to the eye at E; so that the double reflected image *r* appears coincident with the object R itself, seen directly.

When this coincidence is perfect, and the object R so very distant as to make the angle IRH insensible, the position of the speculums I and H will differ insensibly from parallelism; that is, the quadrant will be adjusted for the fore observation. Now it is from the ease and accuracy with which this adjustment can at any time be made, that the fore-observation derives its superiority over the back observation. But by grinding the edge of the index-glass perpendicular to its reflecting surface, and polishing it, the observation is rendered capable of an adjustment equally easy and accurate as the fore horizon-glass: for by a pencil of rays emitted from the object S, incident on the reflecting edge of the index-glass D, thence reflected to the back horizon-glass B, and from that to the eye at *e*, an image will be formed at *s*; which image being made to coincide with the object S itself, seen directly, ascertains the position of the back horizon-glass relative to the index-glass, with the same precision, and in a manner equally direct, as the former operation does that of the fore horizon-glass.

Directions for adjusting the Back Horizon-Glass.

The method of adjusting the quadrant for the back-observation is this. If it is to be done without making use of the telescope, place the index at *o*, and, applying the eye to the hole in the sight vane (K), or tube for directing the sight, direct it through the back horizon-glass to the horizon, if that is the object to be used for adjusting. The two horizons are then to be made to coincide, holding the quadrant first in a vertical and then in a horizontal position; by which means both adjustments will be effected as in the fore-observation.

There will be no difficulty in finding the reflected horizon, if the observer first directs his eye to that part of the horizon-glass where he observes the image of the polished edge of the index-glass, which will appear double. When the direct horizon is made to appear in this case, the reflected one will be seen close by it, unless the instrument wants a great adjustment. In this case, a little motion of the back horizon-glass backwards and forwards will presently bring it in view.

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When the horizon, or any obscure terrestrial object, is to be made use of for adjusting by means of the reflecting edge, there is a precaution to be taken, without which the observer will sometimes meet with what will appear an unaccountable difficulty; for if the sky, or other object behind him, should happen to be pretty bright, he will not be able to discern the horizon at all. This arises from the image of the object behind him, which is reflected from the silvered surface of the index-glass, appearing to coincide with the horizon; in which case, the bright picture of the former, which is formed in the bottom of the eye, prevents the fainter impression of the latter from being perceived. This will be avoided either by applying a black screen over the silvered surface of the index-glass, or, without being at this trouble, by standing at a door or window, so that only the dark objects within can be reflected from the index-glass: but if the observation is to be made in the open air, a hat, or any such dark obstacle, held before the silvered surface of the index-glass, will very effectually remove this inconvenience.

It may be remarked, that some observers, instead of making the principal adjustment, place the speculums parallel, by moving the index without altering the position of the horizon-glass: and the difference between *o* on the vernier and *o* on the limb is the index error, which must be subtracted from all angles measured by the back-observation, when *o* on the index, is to the right of *o* on the limb; and added when to the left.

3. Mr Wright's method of adjusting the back horizon-glass of his improved patent quadrant.

Fig. 58. Is a representation of the quadrant complete in all its parts for use. A, is the reflecting surface of the index-glass, which is made of the usual length, and $\frac{9}{10}$ of an inch broad. The bottom part is covered in front by the brass frame, and the reflecting surface is $\frac{7}{10}$ on the back. B, the fore horizon-glass, placed as usual: O, the back horizon-glass, now placed under the fore sight-vane on the first radius of the quadrant I: C, the sight-vane of the fore horizon-glass: D, the sight-vane of the back horizon-glass: E, the coloured glasses in a brass frame, in the proper place for the fore observation: F, a hole in the frame to receive the coloured glasses when an observation is to be taken with the back horizon-glass in the common way, by turning the back to the sun: G, a hole in the frame of the farthest radius K, to receive the coloured glasses when an observation is to be taken by the new method; which is by looking through the lower hole in the sight-vane of the back horizon-glass, directly at

Fig. 58.

(K) Besides the hole in the sight-vane, commonly made, there must be another nearer to the horizon-glass, and so placed that an eye directed through it to the centre of the horizon-glass shall there perceive the image of the polished edge of the index-glass. This hole must not be made small like the other, but equal to the ordinary size of the pupil of the eye, there being on some occasions no light to spare.

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at the sun in the line of sight DN; the horizon from behind will then be reflected from the back of the index-glass to the horizon-glass, and from thence to the eye. (See fig. 62.) H, a brass clamp on the upper end of the index, having a milled screw underneath, which fastens the round plate to the index when required. (See fig. 59.). IK, the graduated arch of the quadrant divided into 90 degrees: L, the brass index which moves over the graduated arch: M, the vernier to subdivide the divisions on the arch into single minutes of a degree.

Fig. 59. Fig. 59. shows the upper part of the index L on a larger scale, with part of the brass frame that fastens the index-glass, and the three adjusting screws D to adjust its axis vertical to the plane of the quadrant: B, the centre on which the milled plate O moves over the index: The dotted line BF is the distance it is required to move: K, the adjusting screw to stop it in its proper place for adjusting the back observation-glass: G, a piece of brass fastened to the index opposite to the clamp H, to keep the plate O always close to the index L.

Fig. 60. Fig. 60. represents the parallel position of the index and horizon glasses after adjustment by the sun: BC, a ray from the sun incident on the index-glass C, and from thence reflected to the fore horizon-glass D, and again to the eye at E, in the line D E, where the eye sees the sun at A by direct vision, and the image by reflection, in one; the parallel lines AE and BC being so near to each other, that no apparent angle can be observed in the planes of the index and horizon-glass, when adjusted by a distant object.

Fig. 61. In fig. 61. the index-glass is removed 45 degrees from the plane of the fore horizon-glass, and fixed in its proper place for adjusting the back horizon-glass parallel to its plane, in the same manner as the fore horizon-glass is adjusted.

Fig. 62. In fig. 62. the index-glass (after the adjustment of the fore and back horizon-glasses) is carried forward by the index on the arch 90 degrees, and makes an angle of 45° with the plane of the fore horizon-glass, and is at right angles to the plane of the back horizon-glass. The eye at E now sees the sun in the horizon at H, reflected by the index and horizon glasses from the zenith at Z, the image and object being 90 degrees distant. The back horizon K is now reflected from the back surface of the index-glass C to the horizon-glass M, and from thence to the eye at D, in a right line with the fore horizon F. In order to make an exact contact of the fore and back horizons at F, the index must be advanced beyond the 90th degree on the arch, by a quantity equal to twice the dip of the horizon.

The quadrant is adjusted for the fore observation as usual, having previously fixed the index-glass in its proper place by the milled screw at H, as represented in fig. 59.

To adjust the Quadrant for the Back-observation.

Fasten the index to 90° on the limb; loosen the screw H (fig. 59.), and turn the plate O by the milled edge until the end of the adjusting screw K touch the edge of the clamp M; and by means of a distant object observe if the glasses are then parallel, as at fig. 60.: if they are, fasten the screw H; if not, with a screw-driver turn the screw K gently to the right or left to make them perfect, and then fasten the screw. Now remove the index back to O on the limb, and the index-glass will be parallel to the back horizon glass E, fig. 61.; If not, make them so by turning the adjusting screw of the glass E, the eye being at the upper hole in the sight-vane D, and the sight directed to the horizon, or any distant object in the direction DN (fig. 58.). Now the index remaining in this position, the index-glass is to returned, to stop at the pin E, and it will be parallel to the fore horizon-glass as at first: then the quadrant will be adjusted for both methods of observation.

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To observe the Sun's Altitude by the Back-observation.

Remove the coloured glasses to G (fig. 58.), and look through the lower hole in the sight-vane D, in the line of direction DN, directly to the sun, and move the index forward on the arch exactly in the same manner as in the fore-observation: make the contact of the sun's limb and the back horizon exact, and the degrees and minutes shown by the index on the limb is the sun's zenith distance. It may be observed, that the horizon will be inverted. If the sun's lower limb be observed, the semidiameter is to be subtracted from the zenith distance; but if the upper limb is observed, the semidiameter is to be added.

The observation may be made in the usual manner, by turning the back to the sun. In this case the coloured glasses are to be shifted to F, and proceed according to the directions formerly given.

Use of Hadley's Quadrant.

The altitude of any object is determined by the position of the index on the limb, when by reflection that object appears to be in contact with the horizon.

If the object whose altitude is to be observed be the sun, and if so bright that its image may be seen in the transparent part of the fore horizon-glass, the eye is to be applied to the upper hole in the sight vane; otherwise, to the lower hole: and in this case, the quadrant is to be held so that the sun may be bisected by the line of separation of the silvered and transparent parts of the glass. The moon is to be kept as nearly as possible in the same position; and the image of the star is to be observed in the silvered part of the glass adjacent to the line of separation of the two parts.

There are two different methods of taking observations with the quadrant. In the first of these the face of the observer is directed towards that part of the horizon immediately under the sun, and is therefore called the *fore-observation*. In the other method, the observer's back is to the sun, and it is hence called the *back-observation*. This last method of observation is to be used only when the horizon under the sun is obscured, or rendered indistinct by fog or any other impediment.

In taking the sun's altitude, whether by the fore or back observation, the observer must turn the quadrant about upon the axis of vision, and at the same time turn himself about upon his heel, so as to keep the sun always in that part of the horizon-glass which is at the same distance as the eye from the plane of the quadrant. In this way the reflected sun will describe an arch of a parallel circle round the true sun, whose convex side

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will be downwards in the fore-observation and upwards in the back; and consequently, when by moving the index, the lowest point of the arch in the fore observation, or highest in the back, is made to touch the horizon, the quadrant will stand in a vertical plane, and the altitude above the visible horizon will be properly observed. The reason of these operations may be thus explained: The image of the sun being always kept in the axis of vision, the index will always show on the quadrant the distance between the sun and any object seen directly which its image appears to touch; therefore, as long as the index remains unmoved, the image of the sun will describe an arch everywhere equidistant from the sun in the heavens, and consequently a parallel circle about the sun, as a pole. Such a translation of the sun's image can only be produced by the quadrant's being turned about upon a line drawn from the eye to the sun, as an axis. A motion of rotation upon this line may be resolved into two, one upon the axis of vision, and the other upon a line on the quadrant perpendicular to the axis of vision; and consequently a proper combination of these two motions will keep the image of the sun constantly in the axis of vision, and cause both jointly to run over a parallel circle about the sun in the heavens: but when the quadrant is vertical, a line thereon perpendicular to the axis of vision, becomes a vertical axis; and as a small motion of the quadrant is all that is wanted, it will never differ much in practice from a vertical axis. The observer is directed to perform two motions rather than the single one equivalent to them on a line drawn from the eye to the sun: because we are not capable, while looking towards the horizon, of judging how to turn the quadrant about upon the elevated line going to the sun as an axis, by any other means than by combining the two motions above mentioned, so as to keep the sun's image always in the proper part of the horizon-glass. When the sun is near the horizon, the line going from the eye to the sun will not be far removed from the axis of vision; and consequently the principal motion of the quadrant will be performed on the axis of vision, and the part of motion made on the vertical axis will be but small. On the contrary, when the sun is near the zenith, the line going to the sun is not far removed from a vertical line, and consequently the principal motion of the quadrant will be performed on a vertical axis, by the observer's turning himself about, and the part of the motion made on the axis of vision will be but small. In intermediate altitudes of the sun, the motions of the quadrant on the axis of vision, and on the vertical axis, will be more equally divided.

Observations taken with the quadrant are liable to errors, arising from the bending and elasticity of the index, and the resistance it meets with in turning round its centre: whence the extremity of the index, on being pushed along the arch, will sensibly advance before the index-glass begins to move, and may be seen to recoil when the force acting on it is removed. Mr Hadley seems to have been apprehensive that his instrument would be liable to errors from this cause; and in order to avoid them, gives particular directions that the index be made broad at the end next the centre, and that the centre, or axis itself, have as easy a motion as is consistent with steadiness; that is, an entire freedom from looseness, or *shake*, as the workmen term it. By strictly complying with these directions the error in question may indeed be greatly diminished; so far, perhaps, as to render it nearly insensible, where the index is made strong, and the proper medium between the two extremes of a shake at the centre on one hand, and too much stiffness there on the other, is nicely hit; but it cannot be entirely corrected. For to more or less of bending the index will always be subject; and some degree of resistance will remain at the centre, unless the friction there could be totally removed, which is impossible.

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Of the reality of the error to which he is liable from this cause, the observer, if he is provided with a quadrant furnished with a screw for moving the index gradually, may thus satisfy himself. After finishing the observation, lay the quadrant on a table, and note the angle; then cautiously loosen the screw which fastens the index, and it will immediately, if the quadrant is not remarkably well constructed, be seen to start from its former situation, more or less according to the perfection of the joint and the strength of the index. This starting, which is owing to the index recoiling after being released from the confined state it was in during the observation, will sometimes amount to several minutes; and its direction will be opposite to that in which the index was moved by the screw at the time of finishing the observation. But how far it affects the truth of the observation, depends on the manner in which the index was moved in setting it to *o*, for adjusting the instrument; or in finishing the observations necessary for finding the index error.

The easiest and best rule to avoid these errors seems to be this: In all observations made by Hadley's quadrant, let the observer take notice constantly to finish his observations, by moving the index in the same direction which was used in setting it to *o* for adjusting; or in the observations necessary for finding the index error. If this rule is observed, the error arising from the spring of the index will be obviated. For as the index was bent the same way, and in the same degree in adjusting as in observing, the truth of the observations will not be affected by this bending.

To take Altitudes by the Fore-observation.

I. *Of the Sun.*

Turn down either of the coloured glasses before the horizon-glass, according to the brightness of the sun; direct the sight to that part of the horizon which is under the sun, and move the index until the coloured image of the sun appear in the horizon-glass; then give the quadrant a slow vibratory motion about the axis of vision; move the index until the lower or upper limb of the sun is in contact with the horizon, at the lowest part of the arch described by this motion; and the degrees and minutes shown by the index on the limb will be the altitude of the sun.

II. *Of the Moon.*

Put the index to *o*, turn down the green glass, place the eye at the lower hole in the sight-vane, and observe the moon in the silvered part of the horizon-glass; move the index gradually, and follow the moon's reflected image until the enlightened limb is in contact with

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with the horizon, at the lower part of the arch described by the vibratory motion as before, and the index will show the altitude of the observed limb of the moon. If the observation is made in the day-time, the coloured glass is unnecessary.

III. *Of a Star or Planet.*

THE index being put to *o*, direct the sight to the star through the lower hole in the sight-vane and transparent part of the horizon-glass; move the plane of the quadrant a very little to the left, and the image of the star will be seen in the silvered part of the glass. Now move the index, and the image of the star will appear to descend: continue moving the index gradually until the star is in contact with the horizon at the lowest part of the arch described; and the degrees and minutes shown by the index on the limb will be the altitude of the star.

To take Altitudes by the Back-observation.

I. *Of the Sun.*

PUT the stem of the coloured glasses into the perforation between the horizon-glasses, turn down either according to the brightness of the sun, and hold the quadrant vertically; then direct the sight through the hole in the back sight-vane, and the transparent slit in the horizon-glass to that part of the horizon which is opposite to the sun; now move the index till the sun is in the silvered part of the glass, and by giving the quadrant a vibratory motion, the axis of which is that of vision, the image of the sun will describe an arch whose convex side is upwards; bring the limb of the sun, when in the upper part of this arch, in contact with the horizon; and the index will show the altitude of the other limb of the sun.

II. *Of the Moon.*

THE altitude of the moon is observed in the same manner as that of the sun, with this difference only, that the use of the coloured glass is unnecessary unless the moon is very bright; and that the enlightened limb, whether it be the upper or lower, is to be brought in contact with the horizon.

III. *Of a Star or Planet.*

LOOK directly to the star through the vane and transparent slit in the horizon-glass; move the index until the opposite horizon, with respect to the star, is seen in the silvered part of the glass; and make the contact perfect as formerly. If the altitude of the star is known nearly, the index may be set to that altitude, the sight directed to the opposite horizon, and the observation made as before.

SECT. II. *Of finding the Latitude of a Place.*

THE observation necessary for ascertaining the latitude of a place, is that of the meridional altitude of a known celestial object; or two altitudes when the object is out of the meridian. The latitude is deduced with more certainty and with less trouble from the first of these methods, than from the second; and the sun, for various reasons, is the object most proper for this purpose at sea. It, however, frequently happens, that by the interposition of clouds, the sun is obscured at noon; and by this means the meridian altitude is lost. In this case, therefore, the method by double altitudes becomes necessary. The latitude may be deduced from three altitudes of an unknown object, or from double altitudes, the apparent times of observation being given.

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The altitude of the limb of an object observed at sea, requires four separate corrections in order to obtain the true altitude of its centre: these are for *semidiameter*, *dip*, *refraction*, and *parallax*. (See ASTRONOMY, and the respective articles). The first and last of these corrections vanish when the observed object is a fixed star.

When the altitude of the lower limb of any object is observed, its semidiameter is to be added thereto in order to obtain the central altitude; but if the upper limb be observed, the semidiameter is to be subtracted. If the altitude be taken by the back-observation, the contrary rule is to be applied. The dip is to be subtracted from, or added to, the observed altitude, according as the fore or back observation is used. The refraction is always to be subtracted from, and the parallax added to, the observed altitude.

PROB. I. To reduce the sun's declination to any given meridian.

RULE. Find the number in Table IX. answering to the longitude in the table nearest to that given, and to the nearest day of the month. Now, if the longitude is west, and the declination increasing, that is, from the 20th of March to the 22d of June, and from the 22d of September to the 22d of December, the above number is to be added to the declination: during the other part of the year, or while the declination is decreasing, this number is to be subtracted. In east longitude, the contrary rule is to be applied.

Ex. 1. Required the sun's declination at noon 16th April 1810, in longitude 84° W?

Sun's declination at noon at Greenwich	9° 59.2′ N.
Number from Table IX. - -	+ 5.0
Reduced declination - - -	10 4.2

Ex. 2. Required the sun's declination at noon 22d March 1793, in longitude 151° E?

Sun's declination at noon at Greenwich	0° 53′ N
Equation from Table X. - -	— 10
Reduced declination - -	0 43 N

PROB. II. Given the sun's meridian altitude, to find the latitude of the place of observation.

RULE. The sun's semidiameter is to be added to, or subtracted from, the observed altitude, according as the lower or upper limb is observed; the dip answering to the height from Table V. is to be subtracted if the fore-observation is used; otherwise, it is to be added; and the refraction answering to the altitude from Table IV. is to be subtracted: hence the true altitude of the sun's centre will be obtained. Call the altitude south or north, according as the sun is south or north at the time of observation; which subtracted from 90°, will give the zenith distance of a contrary denomination.

Reduce the sun's declination to the meridian of the place of observation, by Prob. I.; then the sum or difference

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ference of the zenith distance and declination, according as they are of the same or of a contrary denomination, will be the latitude of the place of observation, of the same name with the greater quantity.

Ex. 1. October 19. 1810, in longitude 32° E, the meridian altitude of the sun's lower limb was 48° 53′ S, height of the eye 18 feet. Required the latitude?

Obs. alt. sun's lower limb	48° 53′ S	Sun's dec. 19. Oct. noon.	9° 51′ S
Semidiameter	+0 16	Equation Table IX.	— 2
Dip and refraction	—0 5	Reduced declin.	9 49 S
True alt sun's centre	49 4 S	Zenith distance	40 56 N
		Latitude	31 7 N

Ex. 2. November 16. 1812, in longitude 158° W, the meridian altitude of the sun's lower limb was 87° 37′ N, height of the eye 10 feet. Required the latitude?

Obs. alt. sun's low. limb	87° 37′ N.	Sun's dec. noon.	18° 48′ S
Semidiameter	+0 16	Equation tab.	+0 8
Dip and refract.	—0 3	Reduced dec.	19 5 S
True alt. sun's centre	87 50 N.	Zenith distance	2 10 S
		Latitude	21 6 S

Ex. 3. December 19. 1811, being nearly under the meridian of Greenwich, the altitude of the sun's upper limb at noon was 4° 30′ S, height of the eye 20 feet. Required the latitude?

Observed altitude of the sun's upper limb	4° 30′ S
Sun's semidiameter	0 16
Dip and refraction	0 15
True altitude of the sun's centre	3 59 S
Zenith distance	86 1 N
Declination	23 25 S
Latitude	62 36 N

Ex. 4. August 23. 1812, in longitude 107° E, the meridian altitude of the sun's lower limb by the back observation was 61° 8′ N, and the height of the eye 14 feet. Required the latitude?

Observed altitude sun's upper limb	61° 8′ N
Sun's semidiameter	—0 16
Dip	+0 3½
Refraction	—0 ½
True altitude of sun's centre	60 55 N
Zenith distance	29 5 S
Reduced declination	11 26 N
Latitude	17 39 S

The dip in Table V. answers to an entirely open and unobstructed horizon. It, however, frequently happens, that the sun is over the land at the time of observation, and the ship nearer to the land than the visible horizon would be if unconfined. In this case, the dip will be different from what it would otherwise have been, and is to be taken from Table VI. in which the height is expressed at the top, and the distance from the land in the side column in nautical miles.—Seamen, in general, can estimate the distance of any object from the ship with sufficient exactness for this purpose, especially when that distance is not greater than six miles; which is the greatest distance of the visible horizon from an observer on the deck of any ship.

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Prob. III. Given the meridian altitude of a fixed star, to find the latitude of the place of observation.

Rule. Correct the altitude of the star by dip and refraction, and find the zenith distance of the star as formerly; take the declination of the star from Table XI. and reduce it to the time of observation. Now, the sum or difference of the zenith distance and declination of the star, according as they are of the same or of a contrary name, will be the latitude of the place of observation.

Ex. 1. December 1. 1810, the meridian altitude of Sirius was 59° 50′ S, height of the eye 14 feet. Required the latitude?

Observed altitude of Sirius	59° 50′ S
Dip and refraction	—0 4
True altitude	59 46 S
Zenith distance	30 14 N
Declination	16 28 S
Latitude	13 46 N

Ex. 2. February 17. 1797, the meridian altitude of Procyon was 71° 15′ N, the height of the eye 10 feet. Required the latitude?

Observed altitude of Procyon	71° 15′ N
Dip and refraction	—0 3
True altitude	71 12 N
Zenith distance	18 48 S
Declination	5 43 N
Latitude	13 5 S

Prob. IV. Given the meridian altitude of a planet, to find the latitude of the place of observation.

Rule. Compute the true altitude of the planet as directed in last problem (which is sufficiently accurate for altitudes taken at sea); take its declination from the Nautical Almanac, p. iv. of the month, and reduce it to the time and meridian of the place of observation; then the sum or difference of the zenith distance and declination of the planet will be the latitude as before.

Ex. 1. August 7. 1812, the meridian altitude of Saturn was 68° 42′ N, and height of the eye 15 feet. Required the latitude?

Observed altitude of Saturn	68° 42′ N
Dip and refraction	—0 4
True altitude	68 38 N
Zenith distance	21 22 S
Declination	22 42 S
Latitude	44 6 S

Ex. 2. October 15. 1812, the meridian altitude of Jupiter was 81° 5′ S, height of the eye 18 feet. Required the latitude?

Observed

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Observed altitude of Jupiter - -	81° 5′ S	
Dip - - - - -	—0 3	
True altitude - - -	81 2 S	
Zenith distance - - -	8 58 N	
Declination - - -	19 4 S	
Latitude - - - -	10 6 S	

PROB. V. Given the meridian altitude of the moon, to find the latitude of the place of observation.

† *Dr Mackay's Treatise on the Longitude*, Tab. XX.

RULE. Take the number† answering to the ship's longitude, and daily variation of the moon's passing the meridian; which being applied to the time of passage given in the Nautical Almanac, will give the time of the moon's passage over the meridian of the ship.

Reduce this time to the meridian of Greenwich; and by means of the Nautical Almanac find the moon's declination, horizontal parallax, and semidiameter at the reduced time.

Apply the semidiameter and dip to the observed altitude of the limb, and the apparent altitude of the moon's centre will be obtained; to which add the correction answering to the apparent altitude and horizontal parallax ‡, and the sum will be the true altitude of the moon's centre; which subtracted from 90°, the remainder is the zenith distance, and the sum or difference of the zenith distance and declination, according as they are of the same or of a contrary name, will be the latitude of the place of observation.

‡ Ditto, Tab. XX.

Ex. 1. December 24. 1792, in longitude 30° W, the meridian altitude of the moon's lower limb was 81° 15′ N, height of the eye 12 feet. Required the latitude?

Time of pass. over the mer. of Greenwich	=9h 19′
Equation Table XX. - - -	+0 4
Time of pass. over mer. ship - -	9 23
Longitude in time - - - -	2 0
Reduced time - - - -	11 23
Moon's dec. at midnight, Table IX.	=14° 53′ N
Eq. to time from midnight - -	— 0 4
Reduced declination - - -	14 49 N
Moon's hor. par. - - - -	55′ 25″
Moon's semidiameter - - -	15 6
Augmentation - - - -	+ 0 14
Aug. semidiameter - - -	15 20
Observed altitude of the moon's lower limb	81° 15′ N
Semidiameter - - - - -	+ 0 15
Dip - - - -	— 0 3
Apparent altitude of the moon's centre	81 27 N
Correction - - -	+ 0 8
True altitude of moon's centre -	81 35 N
Zenith distance - - -	8 25 S
Declination - - -	14 49 N
Latitude - - - -	6 42 N

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Remark. If the object be on the meridian below the pole at the time of observation, then the sum of the true altitude and the complement of the declination is the latitude, of the same name as the declination or altitude.

Ex. 1. July 2. 1812, in longitude 15° W, the altitude of the sun's lower limb at midnight was 8° 58′, height of the eye 18 feet. Required the latitude?

Observed altitude sun's lower limb -	8° 58′
Semidiameter - - - -	+0 16
Dip and refraction - - -	—0 10
True altitude of sun's centre - -	9 4 N
Compl. declin. reduced to time and place	66 57 N
Latitude - - - -	76 1 N

PROB. VI. Given the latitude by account, the declination and two observed altitudes of the sun, and the interval of time between them, to find the true latitude.

RULE. To the log. secant of the latitude by account, add the log. secant of the sun's declination; the sum, rejecting 20 from the index, is the *logarithm ratio*. To this add the log. of difference of the natural sines of the two altitudes, and the log. of the half elapsed time from its proper column.

Find this sum in column of middle time, and take out the time answering thereto; the difference between which and the half elapsed time will be the time from noon when the greater altitude was observed.

Take the log. answering to this time from column of rising, from which subtract the log. ratio, the remainder is the logarithm of a natural number; which being added to the natural sine of the greater altitude, the sum is the natural cosine of the meridian zenith distance; from which and the sun's declination the latitude is obtained as formerly.

If the latitude thus found differs considerably from that by account, the operation is to be repeated, using the computed latitude in place of that by account (L).

Example 1.

(L) This method is only an approximation, and ought to be used under certain restrictions; namely,

The observations must be taken between nine o'clock in the forenoon and three in the afternoon. If both observations be in the forenoon, or both in the afternoon, the interval must not be less than the distance of the time of observation of the greatest altitude from noon. If one observation be in the forenoon and the other in the afternoon, the interval must not exceed four hours and a half; and in all cases, the nearer the greater altitude is to noon the better.

If the sun's meridian zenith distance be less than the latitude, the limitations are still more contracted. If the latitude be double the meridian zenith distance, the observations must be taken between half past nine in the morning and half past two in the afternoon, and the interval must not exceed three hours and a half. The observations must be taken still nearer to noon, if the latitude exceed the zenith distance in a greater proportion. See Maskelyne's British Mariner's Guide, Dr Mackay's Treatises on the Longitude and Navigation, &c. and Requisite Tables, 2d edit.

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Example 1. July 9. 1811; in latitude by account 27° N. at 10h 29′ A. M. per watch, the corrected altitude of the sun was 65° 24′, and at 12h 31′, the altitude was 74° 8′. Required the true latitude?

Times *per* wat. Alt. N. Sines. Lat. by acc. 37° 0′ Secant c.09765
10h 29′ 63° 24′ 90924 Declination 22 28 Secant c.03428

12 31	74 8	96190	Logarithm ratio -	0.13193
2 2	Differ.	5266	Logarithm -	3.72148
1 1	Half elapsed time		- -	c.57999
31 10″	Middle time		- -	4 43340
29 50	Rising		- -	2.92740
			Log. ratio	c.13193
Natural number	- -	624		2.79547
Greatest altitude	74° 8′ N sine	96190		
Mer zenith dist.	14 30 N cosine	96814		
Declination	22 28			
Latitude -	36 58 N.			

Ex. 2. October 17. 1812, in latitude 43° 24′ N. by account, at 0h 38′ P. M. the correct altitude of the sun's centre was 36° 5′, and at 2h 46′ P. M. the altitude was 24° 49′. Required the latitude?

Times *per* wat Alt. N. Sines Lat. by acc. 43° 24′ Secant c.13872
0h 38′ 36° 5′ 58896 Declination 9 18 Secant c.00575

2 46	24 49	41972	Logarithm ratio -	6.14447
2 8	Differ.	16924	Log. - -	4.22850
1 4 -	Half elapsed time		- -	c.55966
1 41 20″ -	Middle time		- -	4.93263
37 20	Rising		- -	3.12184
			Log. ratio	0.14447
Natural Number		649		2.97737
Greatest altitude -	36° 5′ N. sine	58896		
Mer. zen. distance	53 15 N. cosine	59845		
Declination -	9 18			
Latitude - -	43 57 N.			

Ex. 3. In latitude 49° 48′ N. by account, the sun's declination being 9° 37′ S. at 0h 32′ P. M. per watch, the altitude of the sun's lower limb was 28° 32′, and at 2h 41′ it was 19° 25′, the height of the eye 12 feet. Required the true latitude?

First observed altit.	28° 32′	Second altitude	19° 25′
Semidiameter	+0 16	Semidiameter	+0 16
Dip and refraction	−0 5	Dip and refr.	−0 6
True altitude	28 43	True altitude	19 35

Time *per* wat. Alt. N. Sines. Lat. by acc. 49° 48′ Secant 0.19013
0h 32′ 28° 43′ 48048 Declination 9 37 Secant 0.00615

2 41	19 35	33518	Log. ratio -	c.09628
2 9	Difference	14530	Log. - -	4.16227
1 4 30″ -	Half elapsed time		-	0.55637
1 37 0 -	Middle time		- -	4.91492
32 30	Rising		- -	3 00164
Natural number	-	639	-	2.80536
Mer. zen. dist. 60° 52′ N. cosine		48687		
Declination	9 37 S.			
Latitude	51 15 N.			

As the latitude by computation differs 1° 28′ from that by account, the operation must be repeated. Method of finding the Latitude and Longitude at Sea.

Computed latitude	51° 15′	Secant	0.20348
Declination -	9 37	Secant	0.00615
Logarithm ratio	- -		0.20963
Difference of nat. sines	14530	Log.	4.16227
Half elapsed time	1h 4′ 30″	Log.	0.55637
Middle time -	1 40 20	Log.	4.92827
Rising -	0 35 50	Log.	3.08630
Natural number	- -	753	2.87667
Gr. altitude	28° 43′ N. sine	48048	
Mer. zen. dist.	60 47 N. cosine	48801	
Declination	9 37		
Latitude	51 10		

As this latitude differs only 5′ from that used in the computation, it may therefore be depended upon as the true latitude.

PROB. VII. Given the latitude by account, the sun's declination, two observed altitudes, the elapsed time, and the course and distance run between the observations; to find the ship's latitude at the time of observation of the greater altitude.

RULE. Find the angle contained between the ship's course and the sun's bearing at the time of observation of the least altitude, with which enter the Traverse Table as a course, and the difference of latitude answering to the distance made good will be the reduction of altitude.

Now, if the least altitude be observed in the forenoon, the reduction of altitude is to be applied thereto by addition or subtraction, according as the angle between the ship's course and the sun's bearing is less or more than eight points. If the least altitude be observed in the afternoon, the contrary rule is to be used.

The difference of longitude in time between the observations is to be applied to the elapsed time by addition or subtraction, according as it is east or west. This is, however, in many cases so inconsiderable as to be neglected.

With the corrected altitudes and interval, the latitude by account and sun's declination at the time of observation of the greatest altitude, the computation is to be performed by the last problem.

Ex. 1. July 6. 1793, in latitude 58° 14′ N by account, and longitude 16° E, at 10h 54′ A. M. per watch, the altitude of the sun's lower limb was 53° 17′, and at 1h 17′ P. M. the altitude was 52° 51′, and bearing per compass SW*b*W; the ship's course during the elapsed time was S*b*W½W, and the hourly rate of sailing 8 knots, the height of the eye 16 feet. Required the true latitude at the time of observation of the greater altitude?

Sun's bear at 2d. ob. SW*b*W. Interval bet. observ. 2h 23′
Ship's course S*b*W½W Dist. run = 2h 23 × 8 = 19m.

Contained angle 3½ points.

Now

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Now to course $3\frac{1}{2}$ points, and distance 19 miles, the difference of latitude is 14.7 or 15 miles.

First observed alt.	53° 17′	Second observed alt.	52° 51′
Semidiameter	+0 16	Semidiameter	+0 16
Dip and refract.	−0 4	Dip and refraction	−0 4
True altitude	53 29	Reduction -	−0 15
		Reduced altitude	52 48
Time of ob. of gr. alt.	10h 54′	A. M. Sun's dec.	22° 39′ N.
Longitude in time	1 4	Eq. to r. t.	+ 1
Reduced time	9 50	A. M. Red. decl.	22 40 N.

Time *per* wat.	Alt	N. Sines.	Lat. by acc.	58° 14′	Secant 0.27863
10h 54′	53° 29′	80368	Declination	22 40	Secant 0.03491
1 17	52 48	79653	Logarithm ratio -		0.31354
2 23	Differ.	715	Logarithm -		2.85431
1 11 30″	- -		Half elapsed time		0.51294
5 30	- -		Middle time -		3.68079
1 6 0	-		Rising - -		3.61469
			Log. ratio		0.31354
Natural number	-	-	2001	-	3.30115
Greatest altitude	53° 29′ N.	sine	80368		
Mer. zenith dist.	34 33 N.	cos.	82369		
Declination	22 40 N.				
Latitude -	57 13 N.				

Since the computed latitude differs so much from that by account, it will be necessary to repeat the operation.

Computed latitude .	57° 13′	Secant	0.26643
Declination	22 40	Secant	0.03491
Logarithm ratio - - -			0.30134
Difference of natural sines	715	Log.	2.85431
Half elapsed time	1h 11′ 30″	Log.	0.51294
Middle time	5 20	Log.	3.66859
Rising -	1 6 10	Log.	3.61686
Logarithm ratio -	- -		0.30134
Natural number -	- 2068		3.31552
Greatest altitude	53° 29′ N. sine	80368	
Mer. zen. dist.	34 29 N. cos.	82436	
Declination	22 40 N.		
Latitude	57 9 N.		

As this latitude differs only 4 miles from that used in the computation, it may therefore be depended on as the true latitude.

Remark. If the sun come very near the zenith, the sines of the altitude will vary so little as to make it uncertain which ought to be taken as that belonging to the natural sine of the meridian altitude. In this case, the following method will be found preferable.

To the log. rising of the time from noon found as before, add the log. secant of half the sum of the estimate meridian altitude, and greatest observed altitude; from which subtract the log. ratio, its index being increased by 10, and the remainder will be the log. sine of an arch; which added to the greatest altitude will give the sun's meridian altitude.

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Ex. 2. December 21st 1793, in latitude 22° 40′ S, by account at 11h 57′ the correct altitude of the sun's centre was 89° 10′, and at 12h 4′ 40″, the altitude was 88° 50′. Required the true latitude?

Times *per* wat.	Alt. N. Sines.	Lat. by acc.	22° 40′	Secant	0.03491
11h 57′ 0″	89° 10′ 99989	Declination	23 28	Secant	0.03749
12 4 40	88 50 99979	Logarithm ratio -			0.07240
0 7 10	Differ. 10	Log. - -			1.00000
0 3 50		Half elapsed time - -			1.77663
0 0 50		Middle time - -			2.84903
0 3 0		Rising - - -			9.93284

Comp. of lat. by acc.	67° 20′			
Declination -	23 28			
Sum - -	90 48			
Estimate mer. altitude	89 12	89° 11′	sec.	11.84609
Greatest altitude	89 10			
				12.77893
Logarithm ratio +5	- -			5.07240
Arch - -	0 17		sine	7.70653
Greatest altitude -	89 10			
Meridian altitude	89 27	zen. dist.		0° 33′ N
		declinat.		23 28 S
		latitude		22 55 S

This differing from the assumed latitude, the work must be repeated.

Latitude -	22° 55′	-	secant	0.03571
Declination	23 18	-	secant	0.03749
Logarithm ratio	-	-		0.07320
Difference of natural sines	1°		log.	1.00000
Half elapsed time	3′ 50″			1.77663
Middle time -	0 50			2.84983
Rising - -	3 0			0.93284
Comp. of lat.	67° 5′			
Declination -	23 28			
Sum -	90 33			
Mer. alt. -	89 27	89° 18′	sec.	11.91827
Greatest alt.	89 10			
				12.85111
Log. ratio +5	- -			5.07320
Arch -	0 21	-		7.77791
Greatest altitude	89 10			
Merid. altitude	89 31	zen. dist.		0° 29′
		Declination		23 28
		Latitude		22 59 S

If the work be repeated with this last latitude, the latter part only may be altered.

Method of finding the Latitude and Longitude at Sea.

Latitude -	22° 59′	secant	0.03592
Declination -	23 28	secant	0.03749
Est. mer. alt.	89 31	log. ratio	0.07341
Greatest altitude	89 10	ar. com.—5	4.92659
Sum -	178 41		
Half -	89 20½	secant	1.93972
Rising -	0h 3′ 0″	-	0.93284
Arch -	0 22	sine	7.79915
Greatest altitude	89 10		
Meridian altitude	89 32		
Zenith distance	0 28		
Declination - -	23 28		
Latitude - -	23 0 S.		

PROB. VIII. Given the altitudes of two known stars, observed at the same or at different times; and if at different times, the interval between the observations; to find the latitude.

RULE. If both altitudes be observed at the same time, call the difference between their right ascensions the reduced interval.

But if the altitudes he taken at different times, reduce the interval between the observations to sidereal time, by adding thereto the proportional part answering to the interval, and 3′ 56″, the daily acceleration of the fixed stars. Now to the right ascension of the first observed star, add the interval in sidereal time, and the difference between this sum and the right ascension of the other star will be the reduced interval.

To the logarithm rising of the reduced interval, add the logarithmic cosines of the stars declinations; subtract the natural number answering to the sum of these logarithms from the natural cosine of the difference or sum of the stars declinations, according as they are of the same or of a contrary name, and the remainder will be the natural sine of arch first.

To the logarithmic cosine of arch first add the logarithmic secant of declination of the star having the least polar distance, and the logarithm half elapsed time of the reduced interval, the sum will be the logarithm half elapsed time of arch second.

From the natural cosine of the difference between arch first and the altitude of the star having the greatest polar distance, subtract the natural sine of the altitude of the other star, and find the logarithm of the remainder; to which add the logarithm secant of arch first, and the logarithmic secant of the altitude of the star having the greatest polar distance, the sum will be the logarithm rising of arch third. The difference between arches second and third is arch fourth.

To the logarithm rising of arch fourth add the logarithmic cosines of the declination and altitude of the star having the greatest polar distance; subtract the corresponding natural number from the natural cosine of the difference between the altitude and declination, the polar distance being less than 90°; otherwise, from their sum, and the remainder will be the natural sine of the altitude.

Ex. January 1st 1793, the true altitude of Capella was 69° 23′, and at the same instant the true altitude of Sirius was 16° 19′. Required the latitude?

Method of finding the Latitude and Longitude at Sea.

Right ascension of Capella			5h 1′ 25″	
Right ascension of Sirius			6 36 1	
Interval - - -			1 34 36	
Interval -	1h 34′ 36″	rising		3.92270
Capella's declin.	45° 46′ N	cosine		9.84360
Sirius's declin.	16 27 S	cosine		9.98185
Sum -	62 13 N	cosine	46613	
			5599	3.74815
Arch first	24 13 N	sine	41014	cos. 9.96000
Capella's declin.	45 46	secant		0.15640
Interval -	1h 34′ 36″	H. E. time		0.39670
Arch second	1 11 28	H. E. time		0.51310
Arch first	24 13	secant		0.04000
Sirius's altitude	16 19	secant		0.01785
Difference	7 54 N.	cosine	99051	
Capella's altitude	69 23 N.	sine	93596	
			5455	3.73679
Arch third	1h 21′ 20″	rising		3.79464
Arch second	1 11 28			
Arch fourth	9 52	rising		1.96708
Sirius's declin. -	16 27	cosine		9.98185
altitude -	16 19	cosine		9.98215
Sum - -	32 46 N	cos.	84088	
			85	1.93008
Latitude -	57 9 N	sine	84003	

CHAP. II. *Containing the Method of finding the Longitude at Sea by Lunar Observations.*

SECT. I. *Introduction.*

THE observations necessary to determine the longitude by this method are, the distance between the sun and moon, or the moon and a fixed star near the ecliptic, together with the altitude of each. The stars used in the Nautical Almanack for this purpose are the following: namely, *α Arietis*, *Aldebaran*, *Pollux*, *Regulus*, *Spica Virginis*, *Antares*, *α Aquilæ*, *Fomalhaut*, and *α Pegasi*; and the distances of the moon's centre from the sun, and from one or more of these stars, are contained in the viii. ix. x. and xi. pages of the month, at the beginning of every third hour apparent time, by the meridian of Greenwich. The distance between the moon and the sun, or one of these stars, is observed with a sextant; and the altitudes of the objects are taken as usual with a Hadley's quadrant.

In the practice of this method, it will be found convenient to be provided with three assistants; two of these are to take the altitudes of the sun and moon, or moon and star, at the same time the principal observer is taking the distance between the objects; and the third assistant is to observe the time, and write down

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down the observations. In order to obtain accuracy, it will be necessary to observe several distances, and the corresponding altitudes; the intervals of time between them being as short as possible; and the sum of each divided by the number will give the mean distance and mean altitudes; from which the time of observation at Greenwich is to be computed by the rules to be explained.

If the sun or star from which the moon's distance is observed be at a proper distance from the meridian, the time at the ship may be inferred from the altitude observed at the same time with the distance: in this case, the watch is not necessary; but if that object be near the meridian, the watch is absolutely necessary, in order to connect the observations for ascertaining the apparent time at the ship and at Greenwich with each other.

An observer without any assistants may very easily take all the observations, by first taking the altitudes of the objects, then the distance, and again their altitudes, and reduce the altitudes to the time of observation of the distance; or, by a single observation of the distance, the apparent time being known, the longitude may be determined.

A set of observations of the distance between the moon and a star, and their altitudes, may be taken with accuracy during the time of the evening or morning twilight; and the observer, though not much acquainted with the stars, will not find it difficult to distinguish the star from which the moon's distance is to be observed. For the time of observation nearly, and the ship's longitude by account being known, the estimate time at Greenwich may be found; and by entering the Nautical Almanac with the reduced time, the distance between the moon and given star will be found nearly. Now set the index of the sextant to this distance, and hold the plane of the instrument so as to be nearly at right angles to the line joining the moon's cusps, direct the sight to the moon, and by giving the sextant a slow vibratory motion, the axis of which being that of vision, the star, which is usually one of the brightest in that part of the heavens, will be seen in the transparent part of the horizon glass.

Sect. II. *Of the Sextant.*

This instrument is constructed for the express purpose of measuring with accuracy the angular distance between the sun and moon, or between the moon and a fixed star, in order to ascertain the longitude of a place by lunar observations. It is, therefore, made with more care than the quadrant, and has some additional appendages that are wanting in that instrument.

Plate CCCLXVIII.

Fig. 63. represents the sextant, so framed as not to be liable to bend. The arch AA is divided into 120 degrees; each degree is divided into three parts; each of these parts, therefore, contains 20 minutes, which are again subdivided by the vernier into every half minute or 30 seconds. The vernier is numbered at every fifth of the longer divisions, from the right towards the left, with 5, 10, 15, and 20; the first division to the right being the beginning of the scale.

In order to observe with accuracy, and make the images come precisely in contact, an adjusting screw B is added to the index, which may thereby be moved with greater accuracy than it can be by hand; but this screw does not act until the index is fixed by the finger screw C. Care should be taken not to force the adjusting screw when it arrives at either extremity of its adjustment. When the index is to be moved any considerable quantity, the screw C at the back of the sextant must be loosened; but when the index is brought nearly to the division required, this back screw should be tightened, and then the index may be moved gradually by the adjusting screw.

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There are four tinged glasses D, each of which is set in a separate frame that turns on a centre. They are used to defend the eye from the brightness of the solar image and the glare of the moon, and may be used separately or together as occasion requires.

There are three more such glasses placed behind the horizon glass at E, to weaken the rays of the sun or moon when they are viewed directly through the horizon glass. The paler glass is sometimes used in observing altitudes at sea, to take off the strong glare of the horizon.

The frame of the index glass I is firmly fixed by a strong cock to the centre plate of the index. The horizon glass F is fixed in a frame that turns on the axes or pivots, which move in an exterior frame; the holes in which the pivots move may be tightened by four screws in the exterior frame. G is a screw by which the horizon glass may be set perpendicular to the plane of the instrument: should this screw become loose, or move too easy, it may be easily tightened by turning the capstan headed screw H, which is on one side of the socket through which the stem of the finger screw passes.

The sextant is furnished with a plain tube (fig. 64.) without any glasses; and to render the objects still more distinct, it has two telescopes, one (fig. 65.) representing the objects erect, or in their natural position: the longer one (fig. 66.) shows them inverted; it has a large field of view, and other advantages, and a little use will soon accustom the observer to the inverted position, and the instrument will be as readily managed by it as by the plain tube alone. By a telescope the contact of the images is more perfectly distinguished; and by the place of the images in the field of the telescope, it is easy to perceive whether the sextant is held in the proper place for observation. By sliding the tube that contains the eye-glasses in the inside of the other tube, the object is suited to different eyes, and made to appear perfectly distinct and well defined.

Fig. 64. Fig. 65. Fig. 66.

The telescopes are to be screwed into a circular ring at K; this ring rests on two points against an exterior ring, and is held thereto by two screws: by turning one or other of these screws, and tightening the other, the axis of the telescope may be set parallel to the plane of the sextant. The exterior ring is fixed on a triangular brass stem that slides in a socket, and by means of a screw at the back of the quadrant may be raised or lowered so as to move the centre of the telescope to point to that part of the horizon glass which shall be judged the most fit for observation. Fig. 67. is a circular head, with tinged glasses to screw on the eye end of either of the telescopes or the plain tube. The glasses are contained in a circular plate

Fig. 67.

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which has four holes; three of these are fitted with tinged glasses, the fourth is open. By pressing the finger against the projecting edge of this plate, and turning it round, the open hole, or any of the tinged glasses, may be brought between the eye-glass of the telescope and the eye.

Fig. 68. Fig. 68. is a magnifying glass, to assist the observer to read off the angle with more accuracy: and fig. 69. a screw-driver.

Mr Hoppe of Church-street, Minories, London, has lately contrived a sextant, with two arches, which is, therefore, preferable to the common sextant.

Adjustments of the Sextant.

The adjustments of a sextant are, to set the mirrors perpendicular to its plane and parallel to each other when the index is at zero, and to set the axis of the telescope parallel to the plane of the instrument. The three first of these adjustments are performed nearly in the same manner as directed in the section on the quadrant: as however the sextant is provided with a set of coloured glasses placed behind the horizon glass, the index error may be more accurately determined by measuring the sun's diameter twice, with the index placed alternately before and behind the beginning of the divisions: half the difference of these two measures will be the index error, which must be added to, or subtracted from, all observations, according as the diameter measured with the index to the left of *o* is less or greater than the diameter measured with the index to the right of the beginning of the divisions.

Adjustment IV. *To set the Axis of the Telescope parallel to the Plane of the Instrument.*

Turn the eye end of the telescope until the two wires are parallel to the plane of the instrument; and let two distant objects be selected, as two stars of the first magnitude, whose distance is not less than 90° or 100°; make the contact of these objects as perfect as possible at the wire nearest the plane of the instrument; fix the index in this position; move the sextant till the objects are seen at the other wire, and if the same points are in contact, the axis of the telescope is parallel to the plane of the sextant; but if the objects are apparently separated, or do partly cover each other, correct half the error by the screws in the circular part of the supporter, one of which is above and the other between the telescope and sextant: turn the adjusting screw at the end of the index till the limbs are in contact; then bring the objects to the wire next the instrument; and if the limbs are in contact, the axis of the telescope is adjusted; if not, proceed as at the other wire, and continue till no error remains.

It is sometimes necessary to know the angular distance between the wires of the telescope; to find which, place the wires perpendicular to the plane of the sextant, hold the instrument vertical, direct the sight to the horizon, and move the sextant in its own plane till the horizon and upper wire coincide; keep the sextant in this position, and move the index till the reflected horizon is covered by the lower wire: and the division shown by the index of the limb, corrected by the index error, will be the angular distance between the wires. Other and better methods will readily occur to the observer at land.

Use of the Sextant.

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When the distance between the moon and the sun or a star is to be observed, the sextant must be held so that its plane may pass through the eye of the observer and both objects; and the reflected image of the most luminous of the two is to be brought in contact with the other seen directly. To effect this, therefore, it is evident, that when the brightest object is to the right of the other, the face of the sextant must be held upwards; but if to the left, downwards. When the face of the sextant is held upwards, the instrument should be supported with the right hand, and the index moved with the left hand. But when the face of the sextant is from the observer, it should be held with the left hand, and the motion of the index regulated by the right hand.

Sometimes a sitting posture will be found very convenient for the observer, particularly when the reflected object is to the right of the direct one; in this case, the instrument is supported by the right hand, the elbow may rest on the right knee, the right leg at the same time resting on the left knee.

If the sextant is provided with a ball and socket, and a staff, one of whose ends is attached thereto, and the other rests in a belt fastened round the body of the observer, the greater part of the weight of the instrument will by this means be supported by his body.

To observe the Distance between the Moon and any Celestial Object.

1. Between the Sun and Moon.

Put the telescope in its place, and the wires parallel to the plane of the instrument; and if the sun is very bright, raise the plate before the silvered part of the speculum; direct the telescope to the transparent part of the horizon glass, or to the line of separation of the silvered and transparent parts according to the brightness of the sun, and turn down one of the coloured glasses; then hold the sextant so that its plane produced may pass through the sun and moon, having its face either upwards or downwards according as the sun is to the right or left of the moon; direct the sight through the telescope to the moon, and move the index till the limb of the sun is nearly in contact with the enlightened limb of the moon; now fasten the index, and by a gentle motion of the instrument make the image of the sun move alternately past the moon; and, when in that position where the limbs are nearest each other, make the coincidence of the limbs perfect by means of the adjusting screw: this being effected, read off the degrees and parts of a degree shown by the index on the limb, using the magnifying glass; and thus the angular distance between the nearest limbs of the sun and moon is obtained.

2. Between the Moon and a Star.

Direct the middle of the field of the telescope to the line of separation of the silvered and transparent parts of the horizon glass; if the moon is very bright, turn down the lightest coloured glass; and hold the sextant so that its plane may be parallel to that passing through the eye of the observer and both objects; its face being upwards if the moon is to the right of the star, but if to the left, the face is to be held from the observer; now direct the sight through the telescope to the star, and move

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move the index till the moon appears by the reflection to be nearly in contact with the star; fasten the index, and turn the adjusting screw till the coincidence of the star and enlightened limb of the moon is perfect: and the degrees and parts of a degree shown by the index will be the observed distance between the moon's enlightened limb and the star.

The contact of the limbs must always be observed in the middle between the parallel wires.

It is sometimes difficult for those not much accustomed to observations of this kind, to find the reflected image in the horizon glass: it will perhaps in this case be found more convenient to look directly to the object, and, by moving the index, to make its image coincide with that seen directly.

Sect. III. *Of the Circular Instrument of Reflection.*

This instrument was proposed with a view to correct the error to which the sextant is liable; particularly the error arising from the inaccuracy of the divisions on the limb. It consists of the following parts; a circular ring or limb, two moveable indices, two mirrors, a telescope, coloured glasses, &c.

The limb of this instrument is a complete circle of metal, and is connected with a perforated central plate by six radii: it is divided into 720 degrees; each degree is divided into three equal parts; and the division is carried to minutes by means of the index scale as usual.

The two indices are moveable about the same axis, which passes exactly through the centre of the instrument:—the first index carries the central mirror, and the other the telescope and horizon glass; each index being provided with an adjusting screw for regulating its motion, and a scale for showing the divisions on the limb.

The central mirror is placed on the first index immediately above the centre of the instrument, and its plane makes an angle of about 30° with the middle line of the index. The four screws in its pedestal for making its plane perpendicular to that of the instrument have square heads, and are therefore easily turned either way by a key for that purpose.

The horizon glass is placed on the second index near the limb, so that as few as possible may be intercepted of the rays proceeding from the reflected object when to the left. The perpendicular position of this glass is rectified in the same manner as that of the horizon glass of a sextant, to which it is similar. It has another motion, whereby its plane may be disposed so as to make a proper angle with the axis of the telescope, and a line joining its centre, and that of the central mirror.

The telescope is attached to the other end of the index. It is an achromatic astronomical one, and therefore inverts objects; it has two parallel wires in the common focus of the glasses, whose angular distance is between two and three degrees; and which, at the time of observation, must be placed parallel to the plane of the instrument. This is easily done, by making the mark on the eye-piece coincide with that on the tube. The telescope is moveable by two screws in a vertical direction with regard to the plane of the instrument, but is not capable of receiving a lateral motion.

There are two sets of coloured glasses, each set containing four, and differing in shade from each other. The glasses of the larger set, which belongs to the central mirror, should have each about half the degree of shade with which the correspondent glass of the set belonging to the horizon mirror is tinged. These glasses are kept tight in their places by small pressing screws, and make an angle of about 85° with the plane of the instrument; by which means the image from the coloured glass is not reflected to the telescope. When the angle to be measured is between 5° and 34°, one of the glasses of the largest set is to be placed before the horizon glass.

The handle is of wood, and is screwed to the back of the instrument, immediately under the centre, with which it is to be held at the time of observation.

Fig. 70. is a plan of the instrument, wherein the limb is represented by the divided circular plate; A is the central mirror; *a a*, the places which receive the stems *a a* of the glass, fig. 73.; EF, the first or central index with its scale and adjusting screw; MN, the second or horizon index; GH, the telescope; IK, the screws for moving it towards or from the plane of the instrument; C, the plane of the coloured glass, fig. 72.; and D, its place in certain observations. Fig. 70.

Fig. 71. is a section of the instrument, wherein the several parts are referred to by the same letters as in fig. 70.: Fig. 72. represents one of the horizon coloured glasses; and fig. 73. one of the central coloured glasses: Fig. 74. is the key for turning the adjusting screws of the mirrors: Fig. 75. is the handle: Fig. 76. a section of one of the radii towards its middle: Fig. 77. is used in some terrestrial observations for diminishing the light of the direct object, whose place at the time of observation is D: Fig. 78. is the tool for adjusting the central mirror; and for rectifying the position of the telescope with regard to the plane of the instrument, there is another tool exactly of the same size. The height of these is nearly equal to that of the middle of the central mirror. Fig. 71.

Adjustments of the Circular Instrument.

I. *To set the horizon glass so that none of the rays from the central mirror shall be reflected to the telescope from the horizon mirror, without passing through the coloured glass belonging to this last mirror.*—Place the coloured glass before the horizon mirror; direct the telescope to the silvered part of that mirror, and make it nearly parallel to the plane of the instrument; move the first index; and if the rays from the central mirror to the horizon glass, and from thence to the telescope, have all the same degree of shade with that of the coloured glass used, the horizon glass is in its proper position; otherwise the pedestal of the glass must be turned until the uncoloured images disappear.

II. Place the two adjusting tools on the limb, about 350° of the instrument distant, one on each side of the division on the left, answering to the plane of the central mirror produced: then the eye being placed at the upper edge of the nearest tool, move the central index till one half only of the reflected image of this tool is seen in the central mirror towards the left, and move the other tool till its half to the right is hid by the same edge of the mirror; then, if the upper edges of both tools are apparently in the same straight line,

the

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the central mirror is perpendicular to the plane of the instrument; if not, bring them into this position by the screws in the pedestal of the mirror.

III. *To set the horizon mirror perpendicular to the plane of the instrument.*—The central mirror being previously adjusted, direct the sight through the telescope to any well-defined distant object; then if, by moving the central index, the reflected image passes exactly over the direct object, the mirror is perpendicular; if not, its position must be rectified by means of the screws in the pedestal of the glass.

A planet, or star of the first magnitude, will be found a very proper object for this purpose.

IV. *To make the line of collimation parallel to the plane of the instrument.*—Lay the instrument horizontally on a table; place the two adjusting tools on the limb, towards the extremities of one of the diameters of the instrument; and at about 15 or 20 feet distant let a well defined mark be placed, so as to be in the same straight line with the tops of the tools; then raise or lower the telescope till the plane, passing through its axis and the tops of the tools, is parallel to the plane of the instrument, and direct it to the fixed objects; turn either or both of the screws of the telescope till the mark is apparently in the middle between the wires; then is the telescope adjusted; and the difference, if any, between the divisions pointed out by the indices of the screws will be the error of the indices. Hence this adjustment may in future be easily made.

In this process the eye tube must be so placed as to obtain distinct vision.

V. *To find that division to which the second index being placed the mirrors will be parallel, the central index being at zero.*—Having placed the first index exactly to 0, direct the telescope to the horizon mirror, so that its field may be bisected by the line of separation of the silvered and transparent parts of that mirror; hold the instrument vertically, and move the second index until the direct and reflected horizons agree; and the division shown by the index will be that required.

This adjustment may be performed by measuring the sun's diameter in contrary directions, or by making the reflected and direct images of a star or planet to coincide.

Use of the Circular Instrument.

To observe the Distance between the Sun and Moon.

I. The sun being to the right of the moon.

Set a proper coloured glass before the central mirror, if the distance between the objects is less than 35°; but if above that quantity, place a coloured glass before the horizon mirror: make the mirrors parallel, the first index being at 0, and hold the instrument so that its plane may be directed to the objects, with its face downwards, or from the observer: direct the sight through the telescope to the moon; move the second index, according to the order of the divisions on the limb, till the nearest limbs of the sun and moon are almost in contact: fasten that index, and make the coincidence of the limbs perfect by the adjusting screw belonging thereto; then invert the instrument, and move the central index towards the second by a quantity equal to twice the arch passed over by that index: direct the plane of the instrument to the objects; look directly to the moon, and the sun will be seen in the field of the telescope: fasten the central index, and make the contact of the same two limbs exact by means of the adjusting screw: Then half the angle shown by the central index will be the distance between the nearest limbs of the sun and moon.

II. The sun being to the left of the moon.

Hold the instrument with its face upwards, so that its plane may pass through both objects; direct the telescope to the moon, and make its limb coincide with the nearest limb of the sun's reflected image, by moving the second index: now put the instrument in an opposite position; direct its plane to the objects, and the sight to the moon, the central index being previously moved towards the second by a quantity equal to twice the measured distance; and make the same two limbs that were before observed coincide exactly, by turning the adjusting screw of the first index: then half the angle shown by the first index will be the angular distance between the observed limbs of the sun and moon. This instrument has of late been greatly improved by Captain Mendoza.

To observe the Angular Distance between the Moon and a Fixed Star or Planet.

I. The star being to the right of the moon.

In this case the star is to be considered as the direct object; and the enlightened limb of the moon's reflected image is to be brought in contact with the star or planet, both by a direct and inverted position of the instrument, exactly in the same manner as described in the last article. If the moon's image is very bright, the lightest tinged glass is to be used.

II. The star being to the left of the moon.

Proceed in the same manner as directed for observing the distance between the sun and moon, the sun being to the right of the moon, using the lightest tinged glass, if necessary.

Sect. IV. *Of the Method of determining the Longitude from Observation.*

Prob. I. To convert degrees or parts of the equator into time.

Rule. Multiply the degrees and parts of a degree by 4, beginning at the lowest denomination, and the product will be the corresponding time. Observing that minutes multiplied by 4 produce seconds of time, and degrees multiplied by 4 give minutes.

Ex. 1. Let 26° 45′ be reduced to time.

26° 45′
4

1h 47′ 0″=time required.

Ex. 2. Reduce 83° 37′ to time.

83° 37′
4

Corresponding time=5 34 28

Prob. II. To convert time into degrees.

Rule. Multiply the given time by 10, to which add the half of the product. The sum will be the corresponding degrees.

Ex.

Fig. 1.



Fig. 2.

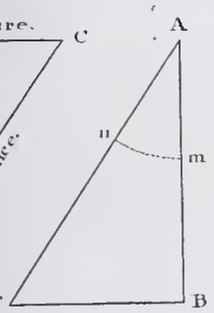


Fig. 3.

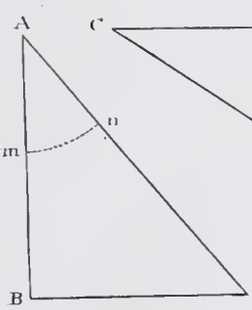


Fig. 4.

Fig. 5.

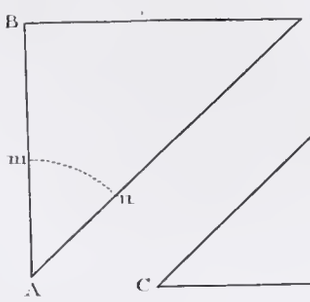


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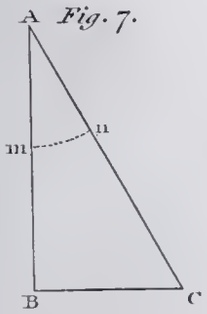


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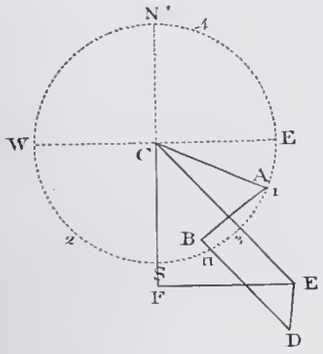


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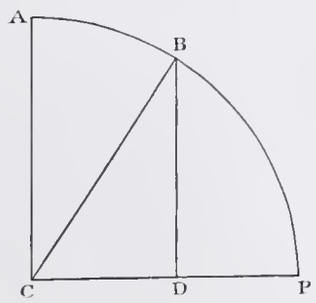


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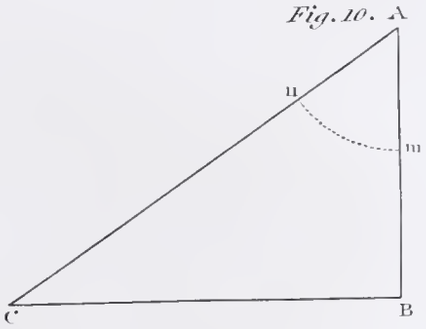


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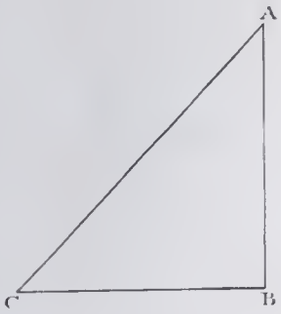


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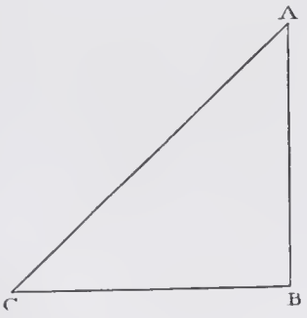


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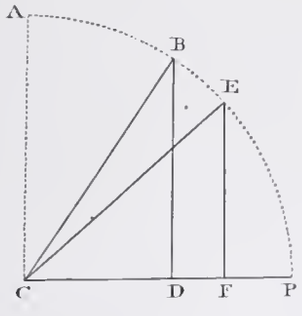


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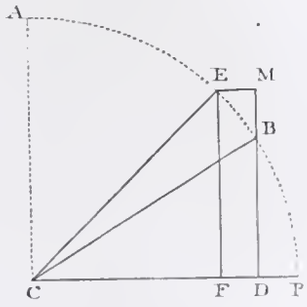


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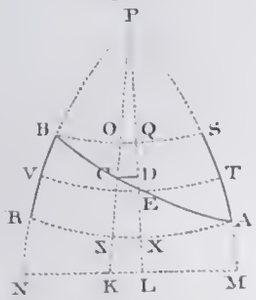


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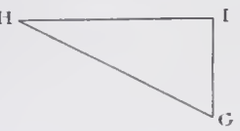


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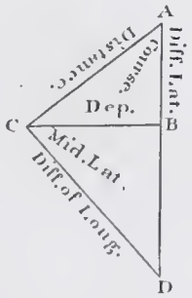


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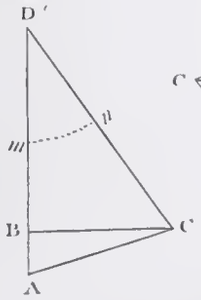


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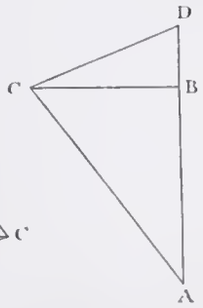


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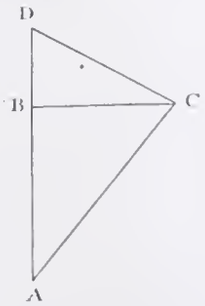


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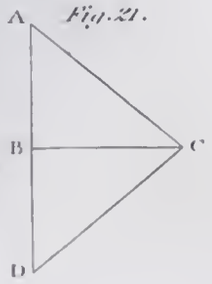


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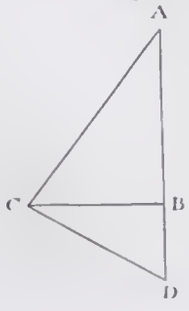


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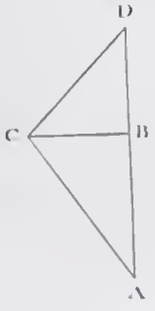


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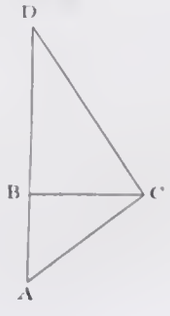


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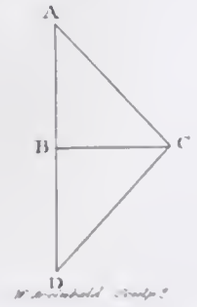


Fig. 26.



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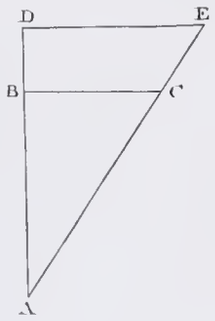


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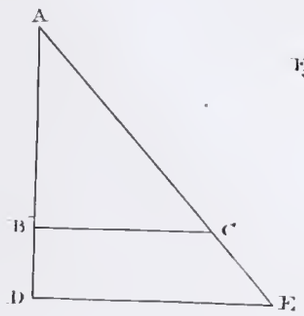


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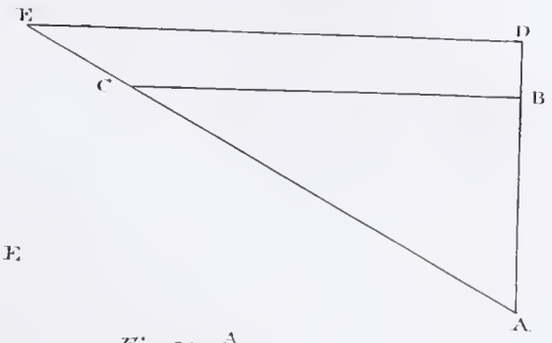


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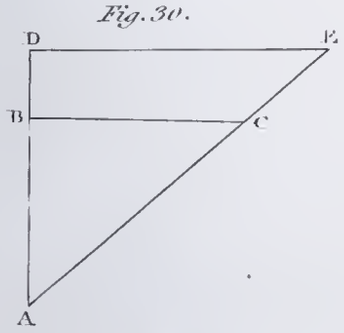


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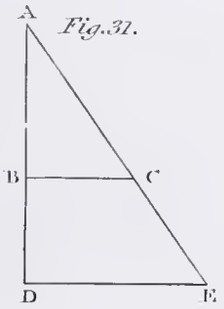


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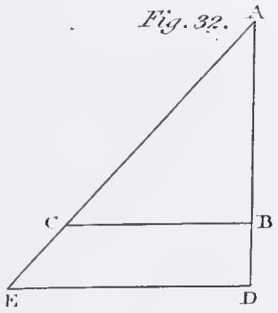


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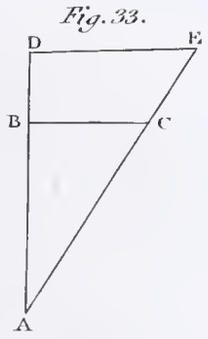


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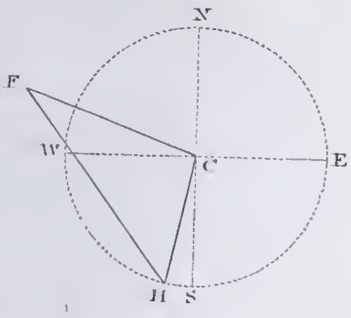


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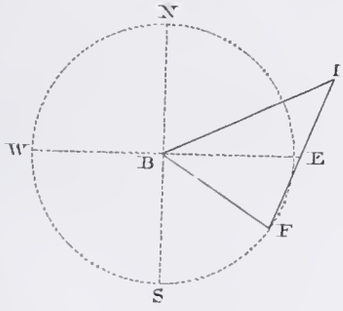


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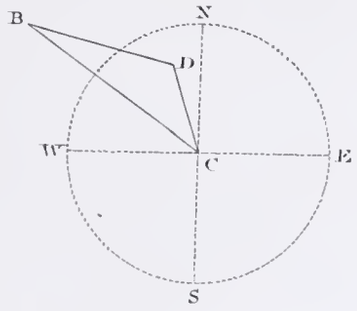


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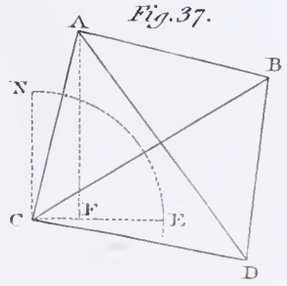


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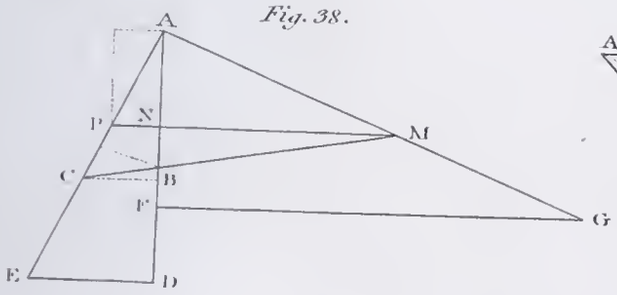


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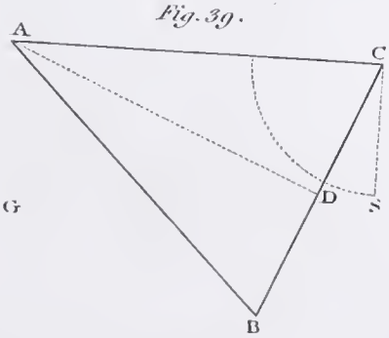


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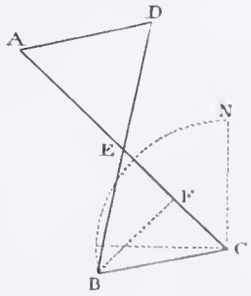


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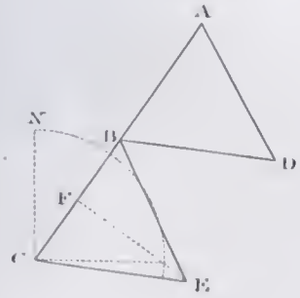


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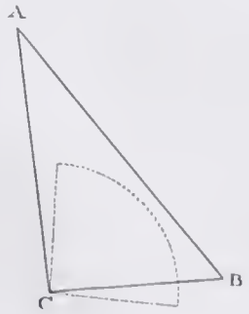


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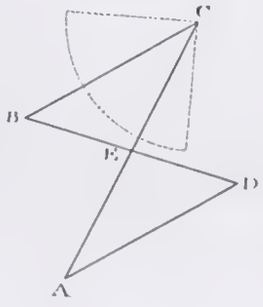


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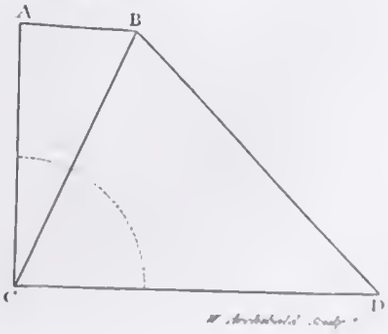


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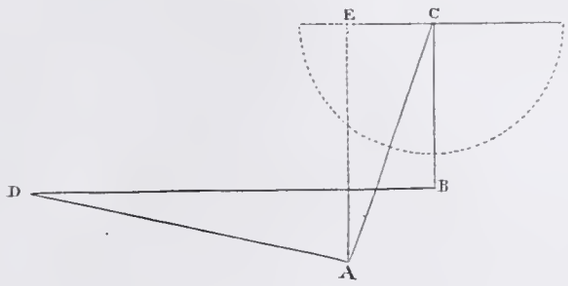


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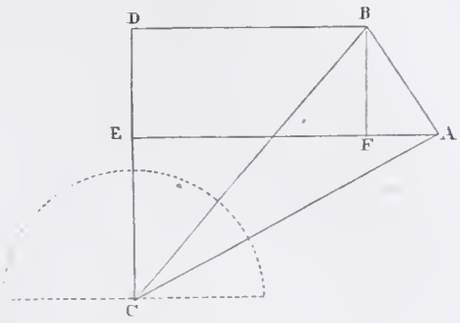


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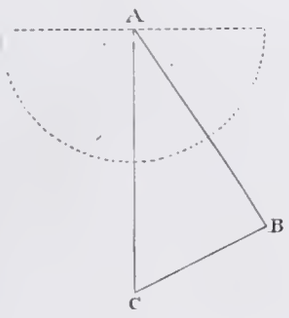


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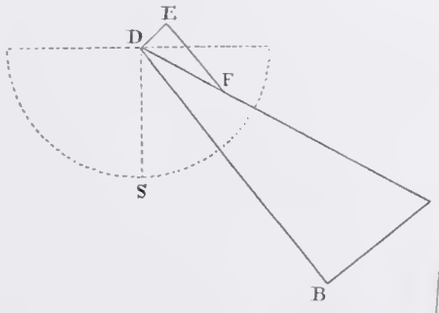


Fig. 50.

Fig. 51.

Fig. 53

Fig. 52.

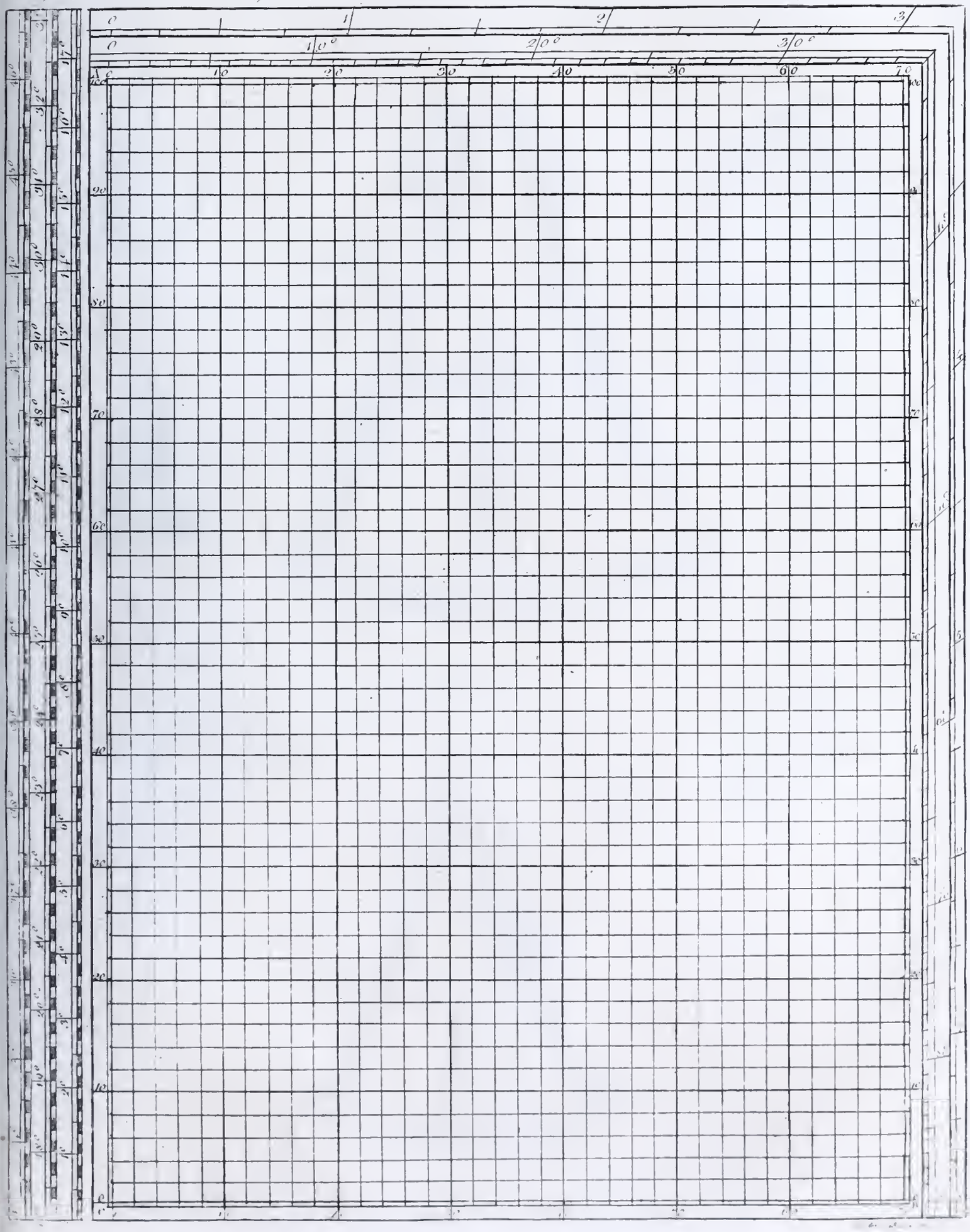


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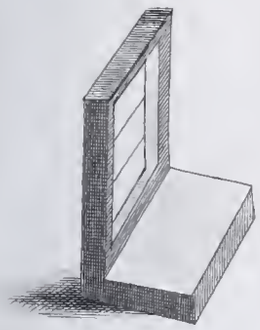


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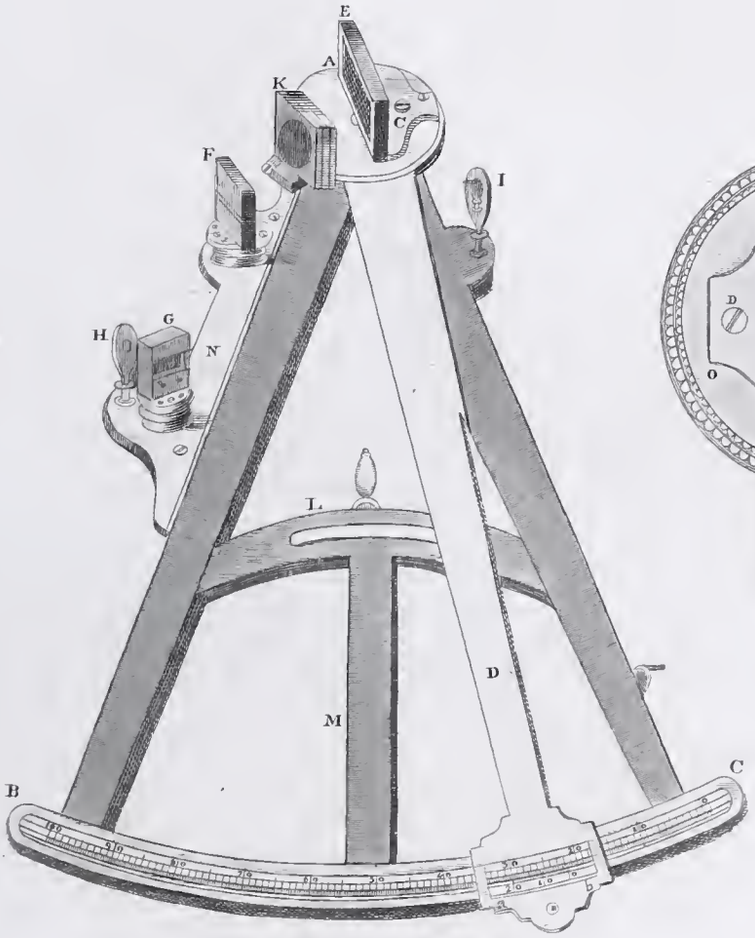


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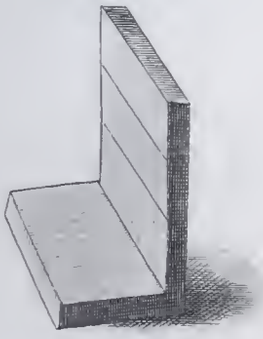


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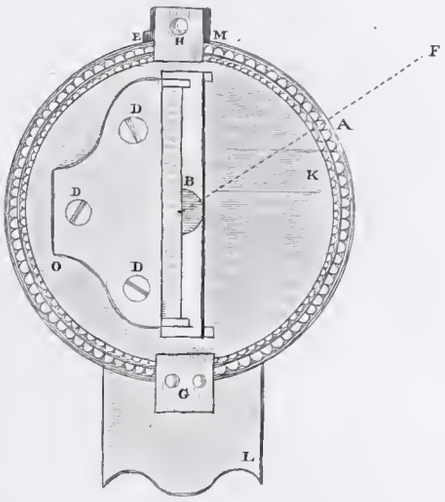


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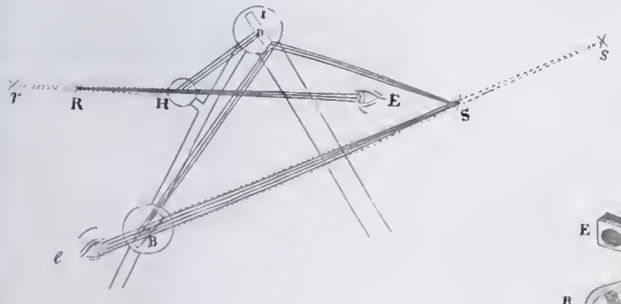


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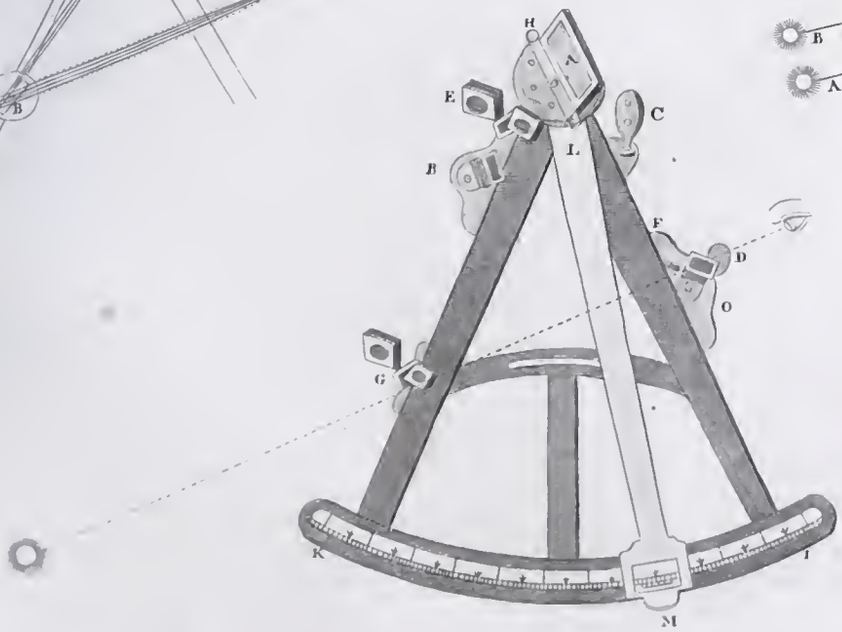
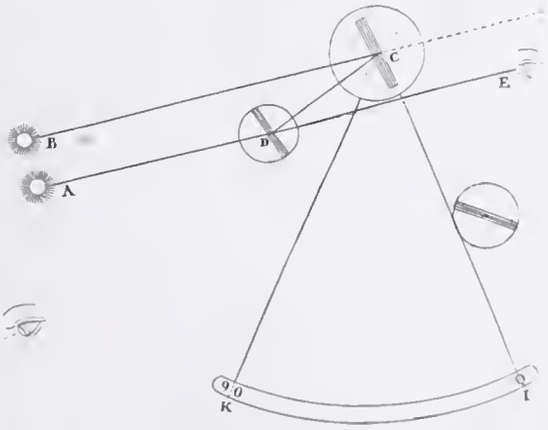


Fig. 60.



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Fig. 61.

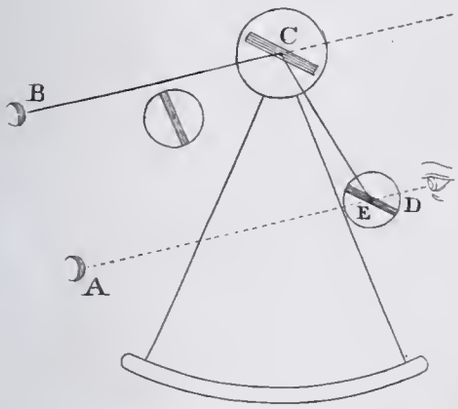


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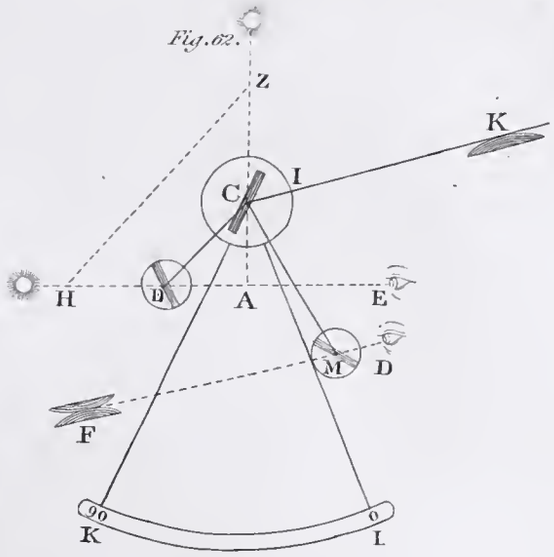


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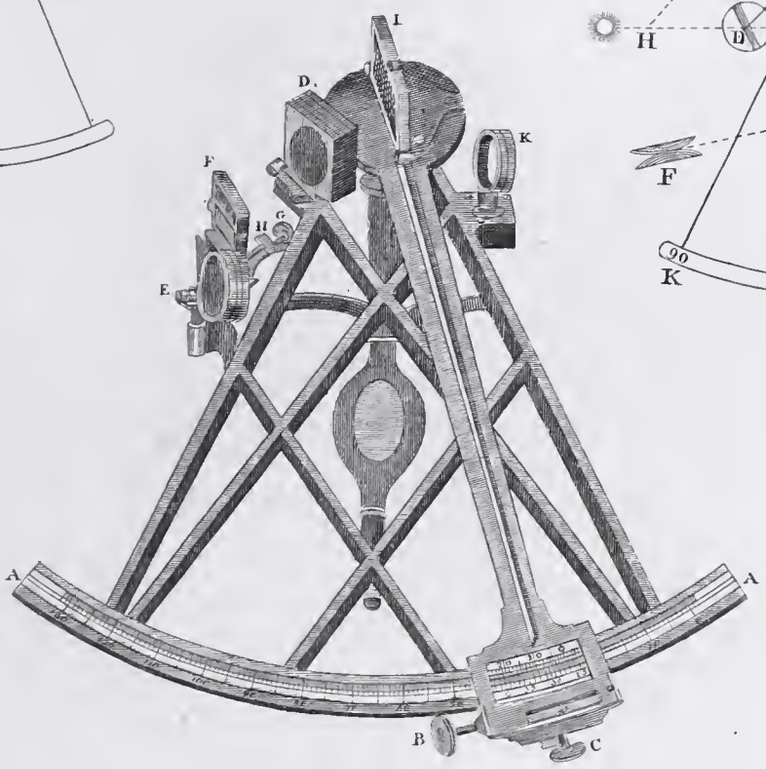


Fig. 64.



Fig. 65.



Fig. 66.



Fig. 67.



Fig. 68.



Fig. 69.



Fig. 70.

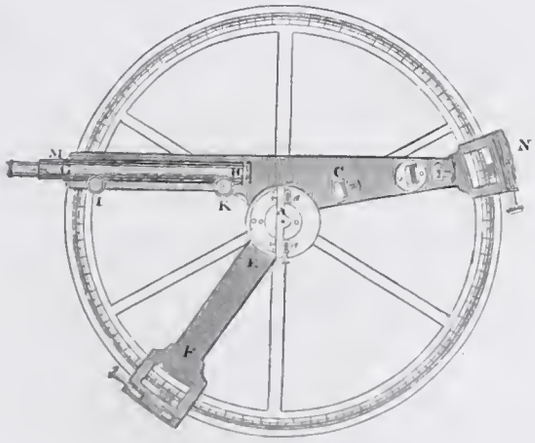


Fig. 71.



Fig. 72.



Fig. 73.



Fig. 74.



Fig. 75.



Fig. 76.

Fig. 77.



Fig. 78.



W. Archibald Sculp.

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Ex. 1. Let 3h 4′ 28″ be reduced to degrees.

	3h	4′	28″
			10
	30	44	40
Half =	15	22	20
Corresponding deg.=	46	7	0

Ex. 2. Reduce 8h 42′ 36″ to degrees.

	8h	42′	36″
			10
	87	6	0
	43	33	0
Answer.	130	39	0

PROB. III. Given the time under any known meridian, to find the corresponding time at Greenwich.

RULE. Let the given time be reckoned from the preceding noon, to which the longitude of the place in time is to be applied by addition or subtraction, according as it is east or west; and the sum or difference will be the corresponding time at Greenwich.

Ex. 1. What time at Greenwich answers to 6h 15′ at a ship in longitude 76° 45′ W?

Time at ship - -	6h	15′
Longitude in time -	5	7 W.
Time at Greenwich	11	22

Ex. 2. Required the time at Greenwich answering to 5h 46′ 39″ of May 1st, at Canton, whose longitude is 113° 2′ 15″ E?

Time at Canton, May 1st,	5h	46′	39″
Longitude in time -	7	32	9 E
Time at Greenwich, April 30.	22	14	30

PROB. IV. To reduce the time at Greenwich to that under any given meridian.

RULE. Reckon the given time from the preceding noon, to which add the longitude in time if east, but subtract it if west; and the sum or remainder will be the corresponding time under the given meridian.

Ex. 1. What is the expected time of the beginning of the lunar eclipse of February 25. 1793, at a ship in longitude 109° 48′ E?

Beg. of eclipse at Greenwich per Naut. Alm.	9h	23′	45′
Ship's longitude in time - -	7	19	12
Time of beginning of eclipse at ship,	16	42	57

Ex. 2. At what time may the immersion of the first satellite of Jupiter be observed at Port St Julian, in longitude 68° 44′ W, which, by the Nautical Almanack, happens at Greenwich 24th March 1792, at 17h 53′ 1″?

App. time of immersion at Greenwich	17h	53′	1″
Longitude of Port St Julian in time	4	34	56 W.
App. time of immer. at Port St Julian	13	18	5

PROB. V. To find the equation of equal altitudes.

RULE. To the cosecant of half the interval of time in degrees add the tangent of the latitude, and to the cotangent of half the interval add the tangent of the declination. Now if the altitude and declination be of a contrary name, add the corresponding natural numbers; but if of the same name, subtract them.—Then to the ar. co. log. of this sum or difference add the proportional logarithm of one-fourth of the interval expressed in time, and the proportional logarithm of the daily variation of declination; the sum will be the proportional logarithm of the equation of equal altitudes in minutes and seconds, which are to be esteemed seconds and thirds.

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Example. Let the latitude of the place of observation be 57° 9′ N, the interval of time between the observations of the equal altitudes 5h 17′, the sun's declination 17° 48′ S, and the daily change of declination 16′ 19″½: Required the equation of equal altitudes?

Half the interval= 2h 38′½=39° 37′.

½ int.=39° 37′ cost.	0.19542	cotang.		0.08209
Lat. 57 9 tan.	0.18997	dec. 17° 48′ ta.		9.50659
	0.38539		2.4288	
			3879	9.58868
Sum - - -			2.8167	ar.co.lo.9.5503
One fourth interval -			1h 19′ 15″	P.L.0.3563
Daily variation of declination			16′ 19″½	P.L.1.0424
Equation of equal altitudes			20″ 14‴	P.L.0.9490

PROB. VI. To find the error of a watch by equal altitudes of the sun.

RULE. In the morning, when the sun is more than two hours distant from the meridian, let a set of observations be taken, consisting, for the sake of greater accuracy, of at least three altitudes, which, together with the corresponding times per watch, are to be wrote regularly, the time of each observation being increased by 12 hours. In the afternoon, observe the instants when the sun comes to the same altitudes, and write down each opposite to its respective altitude. Now half the sum of any two times answering to the same altitude will be the time of noon per watch uncorrected. Find the mean of all the times of noon thus deduced from each corresponding pair of observations, to which the equation of equal altitudes is to be applied by addition or subtraction according as the sun is receding from or approaching to the elevated pole, and the sum or difference will be the time per watch of apparent noon, the difference between which and noon will be the error of the watch for apparent time; and the watch will be fast or slow according as the time of noon thereby is more or less than 12 hours.

Example. January 29. 1786, in lat. 57° 9′ N, the following equal altitudes of the sun were observed: Required the error of the watch?

Alt.=			Time			A.M.			P.M.
8°	5′	-	21h 36′	8″	-	2h 54′	42″		
8	10	-	38	9	-	52	41.2		
8	20	-	39	12.5	-	51	38		
				37·5				4·2	
			21 37	9·37		2 53	41.05		
						21 37	9·37		
Sum - - -						24 30	50.42		
Time of noon per watch uncorrected						12 15	25.2		
Equation of equal altitudes -						=0 0	20.2		
Time per watch of apparent noon						12 15	5.		
Watch fast - - -						15	5.		

The

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The mean time of noon per watch is found by applying the equation of time with a contrary sine.

In practice it will be found convenient to put the index of the quadrant to a certain division, and to wait till either limb of the sun attains that altitude.

PROB. VII. Given the latitude of a place, the altitude and declination of the sun, to find the apparent time, and the error of the watch.

RULE. If the latitude and declination are of different names, let their sum be taken; otherwise, their difference. From the natural cosine of this sum or difference subtract the natural sine of the corrected altitude, and find the logarithm of the remainder; to which add the log. secants of the latitude and declination: the sum will be the log. rising of the horary distance of the object from the meridian, and hence the apparent time will be known.

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Ex. 1. September 15. 1792, in latitude 33° 56′ S, and longitude 18° 22′ E, the mean of the times per watch was 8h 12′ 10″ A. M. and that of the altitudes of the sun's lower limb 24° 48′; height of the eye 24 feet. Required the error of the watch?

Obs. alt. Sun's lower limb -	24° 48′		Sun's declin. at noon per Nautical Almanack		2° 40′.5 S
Semidiameter - - - -	+ 16.0		Equation to 3h 48 A. M. - -		+ 3.7
Dip - - - - -	— 4.7		to 18° 22′ East - - -		+ 1.2
Correction - -	— 1.9		Reduced declination - - -		2 45.4 S
True altitude Sun's centre -	24 57.4				
Latitude - - -	33 56		secant - - - -		0.08109
Declination - -	2 45.4		secant - - - -		0.00050
Sum - - -	36 41.4	nat. cosine	80188		
Sun's altitude - -	24 57.4	nat. sine	42193		
		Difference	37995	log	4.57973
Sun's meridian distance -	3h 48′ 51″	- rising	- - - -		4.66132
Apparent time - - -	8 11 9				
Time per watch - -	8 12 10				
Watch fast - -	1 1				

Ex. 2. May 6. 1793, in latitude 56° 4′ N, and longitude 38° 30′ W, at 4h 37′ 4″ P. M. per watch the altitude of the sun's lower limb was 25° 6′.1, and height of the eye 18 feet. Required the error of the watch for apparent time?

Altitude sun's lower limb -	= 25° 6′.1	-	Sun's declin. per Nautical Almanack		16° 44′.3
Semidiameter - -	+ 15.9	-	Equation to 4h 37′ P. M. - -		+ 3.4
Dip - - -	— 4.1	-	to 38° 30′ W, - - -		+ 1.8
Correction - - -	— 1.9		Reduced declination - - -		16 49.5
True alt. sun's centre -	25 16.0				
Latitude - - -	56 4.0 N	-	secant - - -		0.25319
Declination - -	16 49.5 N.	-	secant - - - -		0.01900
Difference - -	39 14.5	nat. cosine	77448		
Sun's altitude - -	25 16.0	nat. sine	42683		
		Difference	34765	- - -	4.54114
Apparent time - -	4h 38′ 12″	rising	- - - -		4.81333
Time per watch - -	4 37 4				
Watch slow - - -	1 8				

PROB. VIII. Given the latitude of a place, the altitude of a known fixed star, and the sun's right ascension, to find the apparent time of observation and error of the watch.

RULE. Correct the observed altitude of the star, and reduce its right ascension and declination to the time of observation.

With the latitude of the place, the true altitude and declination of the star, compute its horary distance from the meridian by last problem; which being added to, or subtracted from, its right ascension, according as it was observed in the western or eastern hemisphere, the sum or remainder will be the right ascension of the meridian.

From the right ascension of the meridian subtract the sun's right ascension, as given in the Nautical Almanack

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nack for the noon of the given day: and the remainder will be the approximate time of observation; from which subtract the proportional part of the daily variation of right ascension answering thereto, and let the proportional part answering to the longitude be added or subtracted, according as the longitude is east or west, and the result will be the apparent time of observation; and hence the error of the watch will be known.

Ex. 1. December 12. 1792, in lat. 37° 46′ N, and longitude 21° 15′ E, the altitude of Arcturus east of the meridian was 34° 6′.4, the height of the eye 10 feet. Required the apparent time of observation?

Observed alt. of Arcturus	34° 6′.4		
Dip and refraction -	— 4.4		
True altitude -	34 2.0		
Latitude -	37 46.0 N	- sec.	0.10209
Declination -	20 14.4 N	- sec.	0.02778
Difference	17 31.6	N. co.	95358
Altitude of Arcturus	34 2.0	N. sine	55968
	Difference	393904	59539

Arcturus's merid. dist.	4h 8′ 10″	- rising	4.72526
right as. -	14 6 13		
Right as. of merid.	9 58 3		
Sun's right as. -	17 21 59		
Approximate time	16 36 4		
Eq. to approx. time	— 3 3		
Eq. to longitude	+ 16		
Ap. time of obs.	16 33 17		

Ex. 2. January 29. 1792, in latitude 53° 24′ N, and longitude 25° 18′ W, by account, at 14h 58′ 38″, the altitude of Procyon west on the meridian was 19° 58′; height of the eye 20 feet. Required the error of the watch?

Obs. alt. of Procyon	19° 58′		
Dip and refraction	7		
True altitude -	19 51		
Latitude -	53 24	- secant -	0.22459
Declination -	5 45	- secant -	0.00219
Difference -	47 39	nat. cos.	67366
Altitude of Procyon	19 51	nat. sine	33956
		Difference 33410	4.52388

Procyon's merid. dist.	4h 16′ 24″	rising	4.75066
right as. -	7 28 24		
Right as. of merid.	11 44 48		
Sun's right as. -	20 47 22		
Approximate time	14 57 26		
Eq. to ap. time	—0 2 36		
Eq. to long. -	— 0 17		
Apparent time -	14 54 33		
Time per watch -	14 58 38		
Watch fast -	0 4 5		

Prob. IX. Given the altitude of the moon, the latitude of a place, and the apparent time at Greenwich; to find the apparent time at the place of observation.

Rule. Correct the altitude of the moon's limb by Problem V. p. 731, and reduce its right ascension and declination, and the sun's right ascension, to the Greenwich time of observation. Now with the latitude of the place, the declination and altitude of the moon, compute its meridian distance as before: Which being applied to its right ascension by addition or subtraction, according as it is in the western or eastern hemisphere, will give the right ascension of the meridian. Then the sun's right ascension subtracted from the right ascension of the meridian, will give the apparent time of observation.

Example. March 3. 1792, in latitude 51° 38′ N, at 11h 29′ 7″ P. M. per watch, the altitude of the moon's lower limb was 37° 31′, the height of the eye being 10 feet, and the time at Greenwich 13h 43′. Required the error of the watch?

Altitude of the moon's lower limb	= 37° 31′	Moon's right ascension at Green. time -	7h 22′ 54″
Semidiameter - - -	+ 15	declination - - -	17° 0 N
Dip - -	— 3	Sun's right ascension - -	23h 2′ 0″
Correction - -	+ 42		
Corrected alt. of moon's centre	38 25		
Latitude - -	51 38 N	- secant - - -	0.20712
Declination - -	17 0 N	- secant - - -	0.01940
Difference - -	34 38	Nat. cosine 82281	
Moon's altitude - -	38 25	Nat. sine 62138	
		Difference 20143	
Moon's meridian distance -	3° 14′ 36″	rising - - -	4.30412
right ascension -	7 22 54		4.53064
Right ascension of meridian	10 37 30		
Sun's right ascension -	23 2 0		
Apparent time at ship -	11 35 30		
Time per watch -	11 29 7		
Watch slow - -	23		

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PROB. X. Given the apparent distance between the moon and the sun or a fixed star, to find the true distance.

RULE. To the logarithmic difference answering to the moon's apparent altitude and horizontal parallax, add the logarithmic sines of half the sum, and half the difference of the apparent distance and difference of the apparent altitudes; half the sum will be the logarithmic cosine of an arch: now add the logarithm sines of the sum and difference of this arch, and half the difference of the true altitudes, and half the sum will be the logarithmic cosine of half the true distance.

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Example. Let the apparent altitude of the moon's centre be 48° 22′, that of the sun's 27° 43′, the apparent central distance 81° 23′ 40″, and the moon's horizontal parallax 58′ 45″. Required the true distance?

Apparent altitude sun's centre			27°	43′	0″		
Correction			—	1	40		
Sun's true altitude			27	41	20		
Sun's apparent altitude			27	43			
Moon's apparent altitude			48	22			
Difference			20	39			
Apparent distance			81	23	40		
Sum			102	2	40		
Difference			60	44	40		
Half difference true altitudes			10	39	33		
Arch			51	27	29		
Sum			62	7	2		
Difference			40	47	56		
			40	32	16		
					2		
True distance			81	4	32		

Apparent altitude moon's centre			48°	22′	0″		
Correction			+	38	26		
Moon's true altitude			49	0	26		
Sun's true altitude			27	41	20		
Difference			21	19	6		
Half			10	39	33		
Logarithmic difference							9.994638
Half	51°	1′	20″		Sine		9.890639
Half	30	22	20		Sine		9.703820
							19.589097
				cosine			9.794548
				sine			9.946417
				sine			9.815183
							19.761600
				cosine			9.880800

PROB. XI. To find the time at Greenwich answering to a given distance between the moon and the sun, or one of the stars, used in the Nautical Almanack.

RULE. If the given distance is found in the Nautical Almanack opposite to the given day of the month, or to that which immediately precedes or follows it, the time is found at the top of the page. But if this distance is not found exactly in the ephemeris, subtract the prop. log. of the difference between the distances which immediately precede and follow the given distance from the prop. log. of the difference between the given and preceding distances; the remainder will be the prop. log. of the excess of the time corresponding to the given distance, above that answering to the preceding distance: And hence the apparent time at Greenwich is known.

Example. September 21. 1792, the true distance between the centres of the sun and moon was 68° 13′ 8″. Required the apparent time at Greenwich?

Given distance	68°	13′	8″				
Dist. at ix. hours	67	53	27	Diff. =	0°	19′	41″ P. log. 9612
Dist. at xii. hours	69	30	6	Diff. =	1	36	39 P. log. 2701
Excess					0	36	39 P. log. 6911
Preceding time					9	0	0
App. time at Greenwich					9	36	39

PROB. XII. The latitude of a place and its longitude by account being given, together with the distance between, and the altitude of the moon and the sun, or one of the stars in the Nautical Almanack; to find the true longitude of the place of observation.

RULE. Reduce the estimate time of observation to the meridian of Greenwich by Problem III, and to this time, take from the Nautical Almanack, page 7. of the month, the moon's horizontal parallax and semidiameter. Increase the semidiameter by the augmentation answering to the moon's altitude.

Find the apparent and true altitudes of each object's centre, and the apparent central distance; with which compute the true distance by Problem X. and find the apparent time at Greenwich answering thereto by the last problem.

If the sun or star be at a proper distance from the meridian at the time of observation of the distance, compute the apparent time at the ship. If not, the error of the watch may be found from observations taken either before or after that of the distance; or the apparent time may be inferred from the moon's altitude taken with the distance, by Problem IX.

The difference between the apparent times of observation at the ship and Greenwich, will be the longitude of the ship in time; which is east or west according as the time at the ship is later or earlier than the Greenwich time.

Ex. 1. March 17. 1792, in latitude 34° 53′ N, and longitude by account 27° W, about 9h. A. M. the distance between the nearest limbs of the sun and moon was 68° 3′ $\frac{1}{4}$; the altitude of the sun's lower limb 33° 18′; that

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that of the moon's upper limb 31° 3′; and the height of the eye 12 feet. Required the true longitude of the ship?

Time at ship		9h 0′	A. M
Longitude in time		1 48	
Reduced time		10 48	A. M
Altitude moon's upper limb		31 3 0	
Aug. semidiameter		— 16 10	
Dip		— 3 18	
Apparent altitude		30 43 23	
Correction		+ 49 26	
Moon's true altitude		31 32 49	
Sun's apparent altitude		33°30′48″	
Moon's apparent altitude		30 43 23	
Difference		2 47 25	
Apparent distance		68 35 40	
Sum		71 23 5	
Difference		65 48 15	
Half difference true altitudes		0 58 20	
Arch		55 54 12	
Sum		56 52 32	
Difference		54 55 52	
Half true distance		34 6 53	
		2	
True distance		68 13 46	
Distance at XXI hours		69 11 20	
Distance at noon		67 32 38	
Proportional part			
Preceding time			
Apparent time at Greenwich			
Latitude	34° 53′.0 N	Secant	
Declination	0 57 .9 S	Secant	
Sum	35 50 .9	Nat. cosine	81057
Sun's altitude	33 29 .5	Nat. sine	55181
Difference			25876
Time from noon	3h 7′ 13″		
Apparent time	20 52 47		
App. time at Green.	22 45 0		
Longitude in time	1 52 13 = 28° 3′¼ W.		

Dist. sun and moon's nearest limbs		68° 3′ 15″	
Sun's semidiameter		+ 16 6	
Moon's semidiameter		+ 16 10	
Augmentation		+ 0 9	
Apparent central distance		68 35 40	
Altitude sun's lower limb		33 18	
Sun's semidiameter		+ 16 6	
Dip		— 3 18	
Sun's apparent altitude		33 30 48	
Correction		−0 1 19	
Sun's true altitude		33 29 29	
Moon's true altitude		31 32 49	
Difference		1 56 40	
Half		0 58 20	
Logarithmic difference			9.996336
Half	35° 41′ 32″½	Sine	9.765991
Half	32 54 7½	Sine	9.734964
			19.497291
		Cosine	9.748645
		Sine	9.922977
		Sine	9.912998
			19.835975
		Cosine	9.917987
Difference	0° 57′ 34″	P. log.	4951
Difference	1 38 42	P. log.	2610
	1 45 0	Per log.	2341
	21 0 0		
	22 45 0		
Secant			0.08602
Secant			0.00006
			4.41291
	Rising		4.49899

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Example 2. September 2. 1792, in latitude 13° 57′ N, and longitude by account 56° E, several observations of the moon and Altair were taken; the mean of the times per watch was 1^h 18′ 59″ A. M. that of the distance between Altair and the moon's nearest limb 58° 45′ 26″; the mean of the altitude of the moon's lower limb 70° 33′; and that of Altair 25° 27′.4; height of the eye 13 feet. Required the true longitude?

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Time per watch	1^h 18′ 59″ A. M.		Distance moon and Altair			58° 45′ 26″
Longitude in time	3 44 0		Augmented semidiameter			+0 16 28
Reduced time	9 34 59		Apparent central distance			59 1 54
Altitude moon	70° 33′		Altitude of Altair			25 27.4
Semidiameter and dip	—0 13		Dip			—0 3.4
Apparent alt. moon	70 20		Apparent altitude Altair			25 24 0
Correction	+0 19 40		Refraction			—0 2 0
True altitude moon	70 39 40		True altitude Altair			25 22 0
Moon's apparent alt.	70 20		Moon's true altitude			70 39 40
Altair's apparent alt.	25 24		Difference			45 17 40
Difference	44 56		Half			22 38 50
Apparent distance	59 1 54		Logarithmic difference			9.993101
Sum	103 57 54	Half	51° 58′ 57″	Sine		9.896428
Difference	14 5 54	Half	7 2 57	Sine		9.088919
Half diff. true alt.	22 38 50					18.978448
Arch	72 1 57			Cosine		9.489224
Sum	94 40 47			Sine		9.998548
Difference	49 23 7			Sine		9.880301
						18.978448
Half true distance	29 33 48½			Cosine		9.939424
True distance	59 7 37					
Distance at IX hours	58 51 17	Difference	0° 16′ 20′	P. log.		1.0422
—— at XII hours	60 24 34	Difference	1 33 17	P. log.		0.2855
Proportional part			0 31 31	P. log.		0.7567
Preceding time			9 0 0			
Apparent time at Greenwich			9 31 31			
Latitude	13 57 N		Secant			0.01300
Declination	8 19.8 N		Secant			0.00461
Difference	5 37.2	Nat. cosine	99519			
Altitude Altair	25 22.	Nat. sine	42841			
Difference			56678			4.75341
Altair's meridian distance	4^h 23′ 14″	Rising				4.77102
—— right ascension	19 40 40					
Right ascension meridian	0. 3 54					
Sun's right ascension	10 46 17					
Apparent time at ship	13 17 37					
Apparent time at Greenwich	9 31 31					

Longitude in time — 4 46 6 = 56° 31½′ East.

For various other methods of determining the longitude of a place, the reader is referred to Dr Mackay's Treatise on the Theory and Practice of finding the Longitude at Sea or Land.

Variation of the Compass.

Chap. III. *Of the Variation of the Compass.*

The variation of the compass is the deviation of the points of the mariner's compass from the corresponding points of the horizon; and is denominated *east* or *west* variation, according as the north point of the compass is to the east or west of the true north point of the horizon.

A particular account of the variation, and of the several instruments used for determining it from observation, may be seen under the articles Azimuth, Compass, and Variation: and for the method of communicating magnetism to compass needles, see Magnetism.

Prob. I. Given the latitude of a place, and the sun's magnetic amplitude, to find the variation of the compass.

Rule. To the log. secant of the latitude, add the log. sine of the sun's declination, the sum will be the log. cosine of the true amplitude; to be reckoned from the north or south according as the declination is north or south.

The difference between the true and observed amplitudes, reckoned from the same point, and if of the same name, is the variation; but if of a different name, their sum is the variation.

If the observation be made in the eastern hemisphere, the variation will be east or west according as the observed amplitude is nearer to or more remote from the north than the true amplitude. The contrary rule holds good in observations taken in the western hemisphere.

Ex. 1. May 15. 1794, in latitude 33° 10′ N, longitude 18′ W, about 5h A. M. the sun was observed to rise E*b*N. Required the variation?

Sun's dec. May 15. at noon	18° 58′ N.		
Equation to 7h from noon	−0 4		
——— to 18° W	+0 1		
Reduced declination	18 55	Sine	9.51080
Latitude	33 10	Secant	0.07723
True amplitude	N 67 13 E	Cosine	9.58803
Observed amplitude	N 78 45 E		

Variation 11 32; which is *west*, because the observed amplitude is more distant from the north than the true amplitude; the observation being made in the eastern hemisphere.

Ex. 2. December 20. 1793, in latitude 31° 38′ S, longitude 83° W, the sun was observed to set SW. Required the variation?

Latitude	31° 38′	Secant	0.06985
Declination	23 28	Sine	9.60012
True amplitude	S 62 7 W	Cosine	9.66997
Observed ampl.	S 45 0 W		

Variation 17 7; which is *east*, as the observed amplitude is farther from the north than the true amplitude, the observation being made at sunsetting.

It may be remarked, that the sun's amplitude ought to be observed at the instant the altitude of its lower limb is equal to the sum of 15 minutes and the dip of the horizon. Thus, if an observer be elevated 18 feet above the surface of the sea, the amplitude should be taken at the instant the altitude of the sun's lower limb is 19 minutes.

Prob. II. Given the magnetic azimuth, the altitude and declination of the sun, together with the latitude of the place of observation; to find the variation of the compass.

Rule. Reduce the sun's declination to the time and place of observation, and compute the true altitude of the sun's centre.

Find the sum of the sun's polar distance and altitude and the latitude of the place, take the difference between the half of this sum and the polar distance.

To the log. secant of the altitude add the log. secant of the latitude, the log. cosine of the half sum, and the log. cosine of the difference; half the sum of these will be the log. sine of half the sun's true azimuth, to be reckoned from the south in north latitude, but from the north in south latitude.

The difference between the true and observed azimuths will be the variation as formerly.

Ex. 1. November 18. 1793, in latitude 50° 22′ N, longitude 24° 30′ W, about three quarters past eight A. M. the altitude of the sun's lower limb was 8° 10′, and bearing per compass S, 23° 18′ E: height of the eye 20 feet. Required the variation of the compass?

Sun's declin. 18th Nov. at noon	19° 25′ S		Observed alt. sun's lower limb		=° 10
Equation to 3¾h from noon	— 2		Semidiameter		+ 16
——— to 24° 30′ W	+ 1		Dip and refraction		— 10
Reduced declination	19 24		True altitude		8 16
Polar distance	109 24				
Altitude	8 16			Secant	0.00454
Latitude	50 22			Secant	0.19527
Sum	168 2				
Half	84 1			Cosine	9.01803
Difference	25 23			Cosine	9.95591
					19.17375
Half true azimuth	22 43			Sine	9.58687

Half

Variation of the Compass.

Half true azimuth	22° 43′		Sine	9.58687	Ship's Journal.
	2				
True azimuth	S 45 26 E.				
Observed azimuth	S 23 18 E.				
Variation	22 8 W.				

Ex. 2. January 3. 1794, in latitude 33° 52′ N, 53° 15′ E longitude, about half past three the altitude, of the sun's lower limb 41° 18′, and azimuth S 50° 25′ W, the height of the eye being 20 feet. Required the variation?

Sun's declination at noon	21° 24′ S.	Observed alt. sun's lower limb	=41° 18′	
Equation to time from noon	— 2	Sun's semidiameter	+ 16	
——— to longitude	+ 2	Dip and refraction	— 6	
Reduced declination	21 24 S	True altitude	41 28	
Polar distance	111 24			
Altitude	41 28	Secant	0.12532	
Latitude	33 52	Secant	0.08075	
Sum	186 44			
Half	93 22	Cosine	8.76883	
Difference	18 2	Cosine	9.97558	
			18.95048	
	17 23	Sine	9.47524	
	2			
True azimuth	S. 34 46 W.			
Observed azimuth	S. 50 25 W.			
Variation	15 39 W.			

Chap. IV. *Of a Ship's Journal.*

A JOURNAL is a regular and exact register of all the various transactions that happen aboard a ship whether at sea or land, and more particularly that which concerns a ship's way, from whence her place at noon or any other time may be justly ascertained.

That part of the account which is kept at sea is called *sea work;* and the remarks taken down while the ship is in port are called *harbour work.*

At sea, the day begins at noon, and ends at the noon of the following day: the first 12 hours, or those contained between noon and midnight, are denoted by P. M. signifying *after mid day;* and the other 12 hours, or those from midnight to noon, are denoted by A. M. signifying *before mid day.* A day's work marked Wednesday March 6. began on Tuesday at noon, and ended on Wednesday at noon. The days of the week are usually represented by astronomical characters. Thus ☉ represent Sunday; ☽ Monday; ♂ Tuesday; ☿ Wednesday; ♃ Thursday; ♀ Friday; and ♄ Saturday.

When a ship is bound to a port so situated that she will be out of sight of land, the bearing and distance of the port must be found. This may be done by Mercator's or Middle-latitude Sailing; but the most expeditious method is by a chart. If islands, capes, or headlands intervene, it will be necessary to find the several courses and distances between each successively. The true course between the places must be reduced to the course per compass, by allowing the variation to the right or left of the true course, according as it is west or east.

At the time of leaving the land, the bearing of some known place is to be observed, and its distance is usually found by estimation. As perhaps the distance thus found will be liable to some error, particularly in hazy or foggy weather, or when that distance is considerable, it will therefore be proper to use the following method for this purpose.

Let the bearing be observed of the place from which the departure is to be taken; and the ship having run a certain distance on a direct course, the bearing of the same place is to be again observed. Now having one side of a plain triangle, namely the distance sailed, and all the angles, the other distances may be found by Prob. I. of Oblique Sailing.

The method of finding the course and distance sailed in a given time is by the compass, the log-line, and half-minute-glass. These have been already described. In the royal navy, and in ships in the service of the East India Company, the log is hove once every hour; but in most other trading vessels only every two hours.

The several courses and distances sailed in the course of 24 hours, or between noon and noon, and whatever remarks are thought worthy of notice, are set down with chalk on a board painted black, called the *log-board,* which is usually divided into six columns: the first column on the left hand contains the hours from noon to noon; the second and third the knots and parts of a knot sailed every hour, or every two hours, according as the log is marked; the fourth column contains the courses steered; the fifth the winds; and in the sixth the various

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various remarks and phenomena are written. The log-board is transcribed every day at noon into the log-book, which is ruled and divided after the same manner.

The courses steered must be corrected by the variation of the compass and leeway. If the variation is west, it must be allowed to the left hand of the course steered; but if east, to the right hand, in order to obtain the true course. The leeway is to be allowed to the right or left of the course steered, according as the ship is on the larboard or starboard tack. The method of finding the variation, which should be determined daily if possible, is given in the preceding chapter; and the leeway may be understood from what follows.

When a ship is close hauled, that part of the wind which acts upon the hull and rigging, together with a considerable part of the force which is exerted on the sails, tends to drive her to the leeward. But since the bow of a ship exposes less surface to the water than her side, the resistance will be less in the first case than in the second; the velocity in the direction of her head will therefore in most cases be greater than the velocity in the direction of her side; and the ship's real course will be between the two directions. The angle formed between the line of her apparent course and the line she really describes through the water is called the *angle of leeway*, or simply the *leeway*.

There are many circumstances which prevent the laying down rules for the allowance of leeway. The construction of different vessels, their trim with regard to the nature and quantity of their cargo, the position and magnitude of the sail set, and the velocity of the ship, together with the swell of the sea, are all susceptible of great variation, and very much affect the leeway. The following rules, are, however, usually given for this purpose.

1. When a ship is close hauled, has all her sails set, the water smooth, with a light breeze of wind, she is then supposed to make little or no leeway.
2. Allow one point when the top-gallant sails are handed.
3. Allow two points when under close reefed top-sails.
4. Allow two points and a half when one top-sail is handed.
5. Allow three points and a half when both top-sails are handed.
6. Allow four points when the fore course is handed.
7. Allow five points when under the main-sail only.
8. Allow six points when under balanced mizen.
9. Allow seven points when under bare poles.

These allowances may be of some use to work up the day's work of a journal which has been neglected; but a prudent navigator will never be guilty of this neglect. A very good method of estimating the leeway is to observe the bearing of the ship's wake as frequently as may be judged necessary; which may be conveniently enough done by drawing a small semicircle on the tafferel, with its diameter at right angles to the ship's length, and dividing its circumference into points and quarters. The angle contained between the semidiameter which points right aft, and that which points in the direction of the wake, is the leeway. But the best and most rational way of bringing the leeway into the day's log is to have a compass or semicircle on the tafferel, as before described, with a low crutch or swivel in its centre; after heaving the log, the line may be slipped into the crutch just before it is drawn in, and the angle it makes on the limb with the line drawn right aft will show the leeway very accurately; which as a necessary article, ought to be entered into a separate column against the hourly distance on the log-board.

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In hard blowing weather, with a contrary wind and a high sea, it is impossible to gain any advantage by sailing. In such cases, therefore, the object is to avoid as much as possible being driven back. With this intention it is usual to lie to under no more sail than is sufficient to prevent the violent rolling which the vessel would otherwise acquire, to the endangering her masts, and straining her timbers, &c. When a ship is brought to, the tiller is put close over to the leeward, which brings her head round to the wind. The wind having then very little power on the sails, the ship loses her way through the water; which ceasing to act on the rudder, her head falls off from the wind, the sail which she has set fills, and gives her fresh way through the water; which acting on the rudder brings her head again to the wind. Thus the ship has a kind of vibratory motion, coming up to the wind and falling off from it again alternately. Now the middle point between those upon which she comes up and falls off is taken for her apparent course; and the leeway and variation is to be allowed from thence, to find the true course.

The setting and drift of currents, and the heave of the sea are to be marked down. These are to be corrected by variation only.

The computation made from the several courses corrected as above, and their corresponding distances, is called a *day's work;* and the ship's place, as deduced therefrom, is called her place by *account*, or *dead reckoning*.

It is almost constantly found that the latitude by account does not agree with that by observation. From an attentive consideration of the nature and form of the common log, that its place is alterable by the weight of the line, by currents, and other causes, and also the errors to which the course is liable, from the very often wrong position of the compass in the binnacle, the variation not being well ascertained, an exact agreement of the latitudes cannot be expected.

When the difference of longitude is to be found by dead reckoning, if then the latitudes by account and observation disagree, several writers on navigation have proposed to apply a conjectural correction to the departure or difference of longitude. Thus, if the course be near the meridian, the error is wholly attributed to the distance, and the departure is to be increased or diminished accordingly: if near the parallel, the course only is supposed to be erroneous; and if the course is towards the middle of the quadrant, the course and distance are both assumed wrong. This last correction will, according to different authors, place the ship upon opposite sides of her meridian by account. As these corrections are, therefore, no better than guessing, they should be absolutely rejected.

If the latitudes are not found to agree, the navigator ought to examine his log-line and half-minute-glass, and correct the distance accordingly. He is then to consider if the variation and leeway have been properly ascertained: if not, the courses are again to be corrected,

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and no other alteration whatever is to be made on them. He is next to observe if the ship's place has been affected by a current or leave of the sea, and to allow for them according to the best of his judgment. By applying these corrections, the latitudes will generally be found to agree tolerably well; and the longitude is not to receive any farther alteration.

It will be proper, however, for the navigator to determine the longitude of the ship from observation as often as possible; and the reckoning is be carried forward in the usual manner from the last good observation; yet it will perhaps be very satisfactory to keep a separate account of the longitude by dead reckoning.

General Rules for working a Day's Work.

Correct the several courses for variation and leeway; place them, and the corresponding distances, in a table prepared for that purpose. From whence, by Traverse Sailing, find the difference of latitude and departure made good; hence the corresponding course and distance, and the ship's present latitude, will be known.

Find the middle latitude at the top or bottom of the Traverse Table, and the distance, answering to the departure found in a latitude column, will be the difference of longitude: Or, the departure answering to the course made good, and the meridional difference of latitude in a latitude column, is the difference of longitude. The sum, or difference of which, and the longitude left, according as they are of the same or of a contrary name, will be the ship's present longitude of the same name with the greater.

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Compute the difference of latitude between the ship and the intended port, or any other place whose bearing and distance may be required: find also the meridional difference of latitude and the difference of longitude. Now the course answering the meridional difference of latitude found in a latitude column, and the difference of longitude in a departure column, will be the bearing of the place, and the distance answering to the difference of latitude will be the distance of the ship from the proposed place. If these numbers exceed the limits of the Table, it will be necessary to take aliquot parts of them; and the distance is to be multiplied by the number by which the difference of latitude is divided.

It will sometimes be necessary to keep an account of the meridian distance, especially in the Baltic or Mediterranean trade, where charts are used in which the longitude is not marked. The meridian distance on the first day is that day's departure; and any other day it is equal to the sum or difference of the preceding day's meridian distance and the day's departure, according as they are of the same or of a contrary denomination.

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A JOURNAL of a VOYAGE from London to Funchal in Madeira, in his Majesty's Ship the Resolution, A——— M——— Commander, anno 1793.

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Days of month.	Winds.	Remarks on board his Majesty's ship Resolution, 1793.
♄ Sept. 28.	SW	Strong gales and heavy rain. At 3 P. M. sent down topgallant yards; at 11 A. M. the pilot came on board.
☉ Sept. 29.	SW	Moderate and cloudy, with rain. At 10 A. M. cast loose from the sheer hulk at Deptford; got up topgallant yards, and made sail down the river. At noon running through Blackwall reach.
☽ Sept. 30.	SW Variable.	The first part moderate, the latter squally, with rain. At half past one anchored at the Galleons, and moored ship with near a whole cable each way in 5 fathoms, a quarter of a mile off shore. At 3 A. M. strong gales: got down topgallant yards. A. M. the people employed working up junk. Bent the sheet cable.
♂ Octob. 1.	SSW SW	Fresh gales and squally. P. M. received the remainder of the boatswain's and carpenter's stores on board. The clerk of the cheque mustered the ship's company.
☿ Octob. 2.	Variable. N♭E	Variable weather with rain. At noon weighed and made sail; at 5 anchored in Long-reach in 8 fathoms. Received the powder on board. At 6 A. M. weighed and got down the river. At 10 A. M. past the Nore: brought too and hoisted in the boats: double reefed the topsails, and made sail for the Downs. At noon running for the flats of Margate.
♃ Octob. 3.	N♭E N	First part stormy weather; latter moderate and clear. At 4 P. M. got through Margate Roads. At 5 run through the Downs; and at 6 anchored in Dover Road, in 10 fathoms muddy ground. Dover Castle bore north, and the South Foreland NE♭E½E off shore 1¼ miles. Discharged the pilot. Employed making points, &c. for the sails. Scaled the guns.
♀ Octob. 4.	N NNE	Moderate and fair. Employed working up junk. Received from Deal a cutter of 17 feet, with materials. A. M. strong gales and squally, with rain; got down topgallant yards.

Hours.	Kn.	Fa.	Courses.	Winds.	Remarks, ♄ Octob. 5. 1793.
1				NNE	Fresh gales with rain.
2					Hove short.
3					Weighed and made sail.
4	4		WSW		
5	6				
6	7				
7	7				
8	7				Shortened sail.—Dungeness light NE♭E.
9	6	4	W♭N	NE	
10	6				
11	6				
12	6				Fresh breezes and cloudy.
1	6				
2	6				
3	6				
4	6				Ditto weather.
5	6				
6	6				Got up topgallant yards.
7	6				Set studding sails.
8	7				Ditto weather.
9	7	5			
10	7	5			
11	7	6			
12	8				St Alban's Head N¼E.

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A Journal from England towards Madeira.

Ship's Journal.

Hours.	Kn.	Fa.	Courses.	Winds.	Remarks, ⊙ October 6. 1793.
1	8		W*b*N	NE	A fresh steady gale.
2	8				
3	8				
4	8				Do. weather.
5	8				Spoke the Ranger of London, from Carolina.
6	8				Took in studding sails.
7	8				
8	8				Do. weather.
9	8				
10	8				
11	8				Eddistone light N*b*W.
12	8				Do. weather.
1	8				Eddistone light NE.
2	7	5			
3	7	5			
4	7				Do. weather.
5	7		W*b*S		
6	7				Set lower studding sails.
7	7	4			
8	7	6			Fresh breeze and clear weather.
9	7	3			
10	7	5			
11	7	2			
12	7				Do. weather.

Course.	Dist.	D.L.	Dep.	N. Latitude by Acc.	N. Latitude by Obs.	D. Long.	W. Lon. by Acc.	W. Lon. by Obs.	W. Var.		
S. 52° ½ W.	93	57	74	49° 11′	49° 9′	114′ W	6° 18′		2¼ pts.		

As there is no land in sight this day at noon, and from the course and distance run since the last bearing of the Eddistone light was taken, it is not to be supposed that any part of England will be seen, the departure is therefore taken from the Eddistone; and the distance of the ship from that place is found by resolving an oblique-angled plane triangle, in which all the angles are given, and one side, namely, the distance run (16 miles) between the observations. Hence the distance of the Eddistone at the time the last bearing of the light was taken will be found equal to 18 miles; and as the bearing of the Eddistone from the ship at that time was NE, the ship's bearing from the Eddistone was SE. Now the variation 2¼ points W, being allowed to the left of SW, gives S*b*W¼W, the true course. The other courses are in like manner to be corrected, and inserted in the following table, together with their respective distances, beginning at 10 o'clock A. M. the time when the last bearing of the Eddistone was taken. The difference of latitude, departure, course, and distance made good, are to be found by Traverse Sailing.

Courses.	Dist.	Diff. of Lat. N.	Diff. of Lat. S.	Departure. E.	Departure. W.
S*b*W¼W	18		17.0		6.1
W*b*S¼S	22		5.3		21.3
SW¼W	58		34.6		46.6
S 52½°W	93		56.9=57m.		74.0

Latitude of Eddistone - 58 8N.

Latitude by account - 49 11N.
Sum - - - - 99 19
Middle latitude - - 49 40

Now to middle latitude as a course, and the departure 74m. in a latitude column, the difference of long. in a distance column is 114 = 1° 54′W.
Longitude of Eddistone - 4 24 W.

Longitude in by account - 6 18 W.

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A Journal from England towards Madeira.

Ship's Journal.

Hours.	Kn.	Fa.	Courses.	Winds.	Remarks, ☽ October 7. 1793.
1	6	5	WSW	NE	Fresh breezes.
2	6	5			Sounded 62; fine sand.
3	6				
4	5	3			Moderate and cloudy.
5	5				Unbent the cables, and coiled them.
6	5			N	Took in studding sails.
7	5				
8	4	7			Do. weather.
9	4	5			
10	4	5			
11	4				
12	4				Do. weather.
1	4				
2	4				
3	4				
4	4				Light breeze.
5	3		SW$\frac{1}{2}$W	NW	
6	3				A sail S$\frac{1}{2}$E.
7	3				
8	3				Hazy weather.
9	3		SW	Var.	
10	3				
11	3				
12	2				Do. weather.

Course.	Dist	D.L.	Dep.	N. Latitude by Acc.	N. Latitude by Obs.	D. Long.	W. Long. by Acc.	W. Long. by Obs.	W. Var. by acc.	Porto Sancto's Bearing.	Porto Sancto's Distance.
S. 38° W.	99	78	92	47° 51′		93 W.	7° 51′		2$\frac{1}{2}$ pts.	S 23°$\frac{1}{2}$ W.	974 m.

The courses being corrected for variation, and the distances summed up, the work will be as under.

Courses.	Dist.	Diff. of Lat. N.	Diff. of Lat. S.	Departure. E.	Departure. W.
SW$\frac{1}{4}$S	77		57.0		51.7
SSW$\frac{3}{4}$W	12		10.3		6.2
S$\frac{1}{2}$W$\frac{1}{4}$W	11		10.4		3.7
S 38° W	99		77.7		61.6
			1° 8′		

Yesterday's lat. by obser. = 49 9 N
Latitude by account = 47 51 N
Sum - - - 97 0
Middle latitude - 48 30

To middle latitude 48$\frac{1}{2}$°, and departure 61.6 in a latitude column, the corresponding difference of longitude in a distance column is 93′ = 1° 33′ W.
Yesterday's longitude - 9 18 W.
Longitude in by account - 7 51 W.

It is now necessary to find the bearing and distance of the intended port, namely, Funchal; but as that place is on the opposite side of the island with respect to the ship, it is therefore more proper to find the bearing of the east or west end of Madeira; the east end is, however, preferable. But as the small island of Porto Sancto lies a little to the NE of the east end of Madeira, it therefore seems more eligible to find the bearing and distance of that island.

To find the bearing and distance of Porto Sancto.

Latitude of ship	47° 51′ N.	Mer. parts	3278	Longitude of ship	7° 51′ W.
Lat. of Porto Sancto	32 58 N.	Mer. parts	2097	Lon. of Porto Sancto	16 25 W.
Difference of latitude	14 53 = 893.	M. D. Lat.	1181	Difference of long.	8 34 = 514.

The course answering to the meridional difference of latitude and difference of longitude is about 23°$\frac{1}{2}$, and the distance corresponding to the difference of latitude is 974 miles. Now as Porto Sancto lies to the southward and westward of the ship, the course is therefore S 23°$\frac{1}{2}$ W: and the variation, because W, being allowed to the right hand, gives SW$\frac{1}{4}$ W nearly, the bearing per compass; and which is the course that ought to be steered.

Ship's Journal.

A Journal from England towards Madeira.

Ship's Journal.

Hours.	Kn.	Fa.	Courses.	Winds.	Remarks, 3 October 8. 1793.
1	2		SW	NW	Little wind and cloudy.
2	1			Variable.	
3					Tried the current, and found none.
4			Ship's head to the SW		
5					Calm.
6					
7					Calm; a long swell from the SW.
8			Ship's head from SW to SSE		
9					
10	1		WSW	S	
11	1				
12	2				Light airs and hazy.
1	2				
2	2				
3	2				
4	3				Moderate wind and cloudy.
5	3		W	S$\frac{1}{2}$W	
6	4				Set top-gallant sails.
7	5				
8	5				
9	5				
10	5		W$\frac{1}{2}$N	SSW	
11	5				By double altitudes of the sun, the latitude
12	5				was found to be 47° 28′ N.

Course.	Dist.	D.L.	Dep.	N. Latitude by Acc.	N. Latitude by Obs.	D. Long.	W. Long. by Acc.	W. Long. by Obs.	W. Var.	Porto Sancto's Bearing.	Porto Sancto's Distance.
S 61° W	51	25	45	47° 28′	47° 28′	67′ W.	8° 38′		2 points.	S 21° W	932

The several courses corrected will be as under.

Courses.	Dist.	Diff. of Latit. N.	Diff. of Latit. S.	Departure. E.	Departure. W.
SSW	3		2.8		1.1
SW	23		9.2		9.2
WSW	22		8.4		20.3
W$\frac{1}{2}$S$\frac{1}{2}$S	15		4.4		14.4
S 61° W	15		24.8 = 25		45.0

Yesterday's latitude 47 51

Latitude by account 47 26
Sum - - - 77
Middle latitude - 47 39

To middle latitude 37$\frac{1}{2}$°, and departure 45′ in a latitude column, the difference of longitude in a distance column is 67′ = 1° 7′ W.

Yesterday's longitude 7 51 W.

Longitude in by account 8 58 W.

To find the bearing and distance of Porto Sancto.

Latitude of ship	47° 28 N.	Mer. parts	3244	Longitude	8° 58′ W.
Lat. of Porto Sancto	32 58 N.	Mer. parts	2097	Longitude	16 25 W.
Difference of latitude	14 30 = 870	M. D. lat.	1147	D. longitude	7 27 = 447.

Hence the bearing of Porto Sancto is S 21° W, and distance 932 miles. The course per compass is therefore SW nearly.

A Journal from England towards Madeira.

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Hours.	Kn.	Fa.	Courses.	Winds.	Remarks, 8 October 9. 1793.
1	5		W b N	SW b S	Squally with rain.
2	5				Handed top-gallant sails.
3	5	5			In first reef topsails.
4	5	4			Dark gloomy weather. Tacked ship.
5	5	6	SE b S		
6	5				In 2d reef topsails, and down top-gallant yards.
7	4				
8	4				Stormy weather; in fore and mizen top-sails and 3d
9	3				reef main top-sail. Handed the main top-sail, bent
10			up SE b S off ESE		the main stay-sail, and brought to with it and the
11	}		up WSW off WNW		mizen; reefed the mainsail; at 10, wore and lay to
12	}				under the mainsail, got down top-gallant masts; at
1	3		W b W		12 set the foresail, and balanced the mizen.
2	3	6			
3	3	5	WNW	SW	The sea stove in several half ports.
4	3	5			
5	4				The swell abates a little.
6	4		W b N	SW b S	
7	3	2			The swell abates fast.
8	3	4			Up top-gallant masts.
9	3	4	W	SSW	
10	4				Set the top-sails.
11	5				
12	5				Clear weather; good observation.

Course.	Dist.	D.L.	Dep.	N. Latitude by		D. Long.	W. Long. by		W. Var.	Porto Sancto's	
				Acc.	Obs.		Acc.	Obs.		Bearing.	Distance.
W b N ½ N	43	12	41	47° 40′	47° 39′	61′	9° 59′		2 points		

There is no leeway allowed until two o'clock P. M. when the top-gallant sails are taken in; from 2 to 3 one point is allowed; from 3 to 6, one and a half points are allowed; from 6 to 8, one and three-fourth points are allowed; from 8 to 9, three points; from 9 to 10, four and a half points; from 10 to 12, five points; from 12 to 10 A. M. three and a half points; and from thence to noon two points leeway are allowed. Now the several courses being corrected by variation and leeway will be as under; but as the corrected courses from 2 to 3 P. M. and from 10 to 12 A. M. are the same, namely, west; this, therefore, is inserted in the table, together with the sum of the distances, as a single course and distance. In like manner the courses from 12 to 2, and from 5 to 8, being the same, are inserted as a single course and distance.

Courses.	Dist.	Diff. of Lat.		Departure.	
		N.	S.	E.	W.
W b S	10		2.0		9.8
W	15.5				15.5
W ½ N	5.4	0.5			5.4
E b S ½ S	10.6		3.1	10.1	
E b S ¼ S	8		1.9	7.8	
E	3			3.0	
N E b E	1	0.6		0.8	
N W b W	2	1.1			1.7
N W b W ½ W	17.2	8.1			15.2
N W ½ W	1	7.0			8.5
W b N ½ N	7.4	2.1			7.1
		19.4	7.0	21.7	63.2
		7.0			21.7
W b N ½ N	43	12.4			41.5

Yest. latitude 47 28 N.
Lat. by account 47 40 N.
To middle latitude 37° 34′, and departure 41.5 the difference of longitude is 61′ = 1° 1′ W.
Yesterday's longitude 8 58 W.
Longitude in by account 9 59 W.

A Journal

Ship's Journal.

A Journey from England towards Madeira.

Ship's Journal.

Hours.	Kn.	Fa.	Courses.	Winds.	Remarks, 4 October 10. 1793.
1	5	3	W	SSW	Fresh gales with rain.
2	5	7			
3	6				
4	6				Do. weather.
5	6				Out 3d reef topsails.
6	6				Lost a log and line.
7	5	6			
8	5	4			Do. weather.
9	5	5			
10	5	2			
11	5				
12	5				Do. weather.
1	5	5			
2	5				
3	5				
4	4				Moderate and cloudy, out all reefs.
5	4		WSW	S	
6	4				Sprung fore topgallant yard, got up another.
7	4	3			
8	4	4	SW$\flat$W	SSE	Do. weather.
9	4	6			A sail NE.
10	5	3			Employed working up junk.
11	5	4		SE$\flat$S	A swell from the NW, which by estimation has
12	5				set ship 7 miles in the opposite direction.

Course.	Dist.	D.L.	Dep.	N. Latitude by Acc.	N. Latitude by Obs.	D. Long.	W. Long. by Acc.	W. Long. by Obs.	W. Var.	Porto Sancto's Bearing.	Porto Sancto's Distance.
S 74° W.	108	36	104	47° 9′		153′ W.	12° 31′		2 Points.	S 12° W.	870 m.

Two points leeway are allowed on the first course, one on the second; and as the ship is 7 points from the wind on the third course, there is no leeway allowed on it. The opposite point to NW, that from which the swell set, with the variation allowed upon it, is the last course in the Traverse Table.

Courses.	Dist.	Diff. of Lat. N.	Diff. of Lat. S.	Departure. E.	Departure. W.
W	86.2				86.2
SW$\flat$W	12.3		6.8		10.2
SW$\flat$S	24.7		20.5		13.7
ESE	7		1.7	6.5	
S 74 W	108		30.0	6.5	110.1
Yesterday's latitude		47 39			6.5
Latitude by account		47 9			103.6
Sum - -		48			
Middle latitude		47 24			

To middle latitude 47 24, and departure 103.6, the difference of longitude is 153′ = 2° 33′ W.
Yesterday's longitude - 9 59 W.
12 32 W.

To find the bearing and distance of Porto Sancto.

Latitude of ship -	47° 9′	Mer. parts -	3216	Longitude -	12° 32′ W
Lat. Port Sancto -	32 58	Mer. parts -	2097	Longitude -	16 25 W
Difference of latitude	14 11 = 851′ M. D. lat.		1119	D. Longitude	3 53 = 233

Hence the bearing of Porto Sancto is S 12° W, and distance 870 miles; the course per compass is therefore about SW$\flat$W.

A Journal

Ship's Journal.

A Journal from England to Madeira.

Ship's Journal.

Hours.	Kn.	Fa.	Courses.	Winds.	Remarks, ♀ October 11. 1793.
1	4		SW*b*S	ESE	Moderate wind and fair weather.
2	3				Shortened sail and set up the topmast rigging.
3	2				
4	3				Do. weather.
5	4				Variation per amplitude 21° W.
6	4	6			
7	4	4			
8	4	5			A fine steady breeze.
9	5			E.	By an observation of the moon's distance from
10	5				*α* Pegasi, the ship's longitude at half past 8
11	5				was 12° 28′ W.
12	5	2			Clear weather.
1	5	7			
2	6				
3	6			ENE	
4	6				Do. weather.
5	6	2			
6	6				
7	6	3			
8	6				Set studding sails, &c.
9	7				
10	7				One sail in sight.
11	8				
12	8				Do. weather, good observation.

Course.	Dist.	D.L.	Dep	N. Latitude by		D. Long.	W. Long. by		W. Var. Observed.	Porto Sancto's	
				Acc.	Obs.		Acc.	Obs.		Bearing.	Distance.
S 12° 45′ W.	128	125	28	45° 4′	44° 59′	41° W.	13° 13′	12° 59′	21°	S 12° W.	737 miles.

The observed variation 21° being allowed to the left of SW*b*S gives S 12° 45′ W, the corrected course, and the distance summed up is 127.9, or 128 miles. Hence the difference of latitude is 124.8, and the departure 28.2. The latitude by account is therefore 45° 4′ N, and the middle latitude 46° 6′, to which, and the departure 28.2 in a latitude column, the difference of longitude in a distance column is 41′ W; which being added to 12° 32′ W, the yesterday's longitude gives 13° 13′ W, the longitude in by account. But the longitude by observation was 12° 28′ W at half past 8 P. M.; since that time the ship has run 96 miles; hence the departure in that interval is 21.2 m. Now half the difference of latitude 47 m. added to 44° 59′, the latitude by observation at noon, the sum 45° 46′ is the middle latitude; with which and the departure 21.2, the difference of longitude is found to be 31′ W; which, therefore, added to 12° 28′, the longitude observed, the sum is 12° 59. W, the longitude by observation reduced to noon.

To find the bearing and distance of Porto Sancto.

Latitude ship - -	44° 59′ N.	Mer. parts -	3028	Longitude -	12° 59′ W
Lat. Porto Sancto -	32 58 N.	Mer. parts -	2097	Longitude -	16 25 W
Difference of latitude -	12 1=721	M. D. lat.	931	D. Longitude - -	3 26=206′

Hence the bearing of Porto Sancto is S 12° W, and distance 737 miles. The course to be steered is therefore S 33° W, or SW*b*S nearly.

A Journal

Ship's Journal.

A Journal from England to Madeira.

Ship's Journal.

Hours.	Kn.	Fa.	Course.	Winds.	Remarks, ♄ October 12. 1793.
1	8		SW*b*S	E*b*N	Fresh gales, and cloudy.
2	7	5			
3	8				
4	8	6			Do. weather.
5	8	4			
6	8				Hauled down studding sails.
7	7	5			
8	7	3			Do. weather.
9	7	4			
10	7	2			
11	7	6			
12	7	5		ENE	A steady gale and fine weather.
1	7				
2	7	5			
3	7				
4	7	3			Do. weather.
5	7	2			
6	7				
7	7	4			Out studding sails alow and aloft.
8	8				Variation per azimuth 20° 14′ W.
9	8				A sail in the SW quarter.
10	8				
11	7	6			Sailmaker altering a lower studding sail.
12	8				Fine weather, and cloudy.

Course.	Dist.	D.L.	Dep.	N. Latitude by		D. Long.	W. Long. by		W. Var. Obs.	Porto Sancto's	
				Acc.	Obs.		Acc.	Obs.		Bearing.	Distance.
S 13° 31′ W.	183	178	43	42° 1′		59′ W.	14° 12′	13° 58′	20° 14′	S 12° 14′	555 m.

The course corrected by variation is S 23 31′W, and the distance run is 183 miles; hence the difference of latitude is 177.9, and the departure 42.8.

Yesterday's latitude by observation	44° 59′N.	Mer. parts - -	3028
Difference of latitude -	2 58 S.		
Latitude in by account - -	42 1 N.	Mer. parts - -	2783
Meridional difference of latitude - - - - - - - -			245

Now to course $13\frac{1}{2}^{0}$, and meridional difference of latitude 245 in a latitude column, the difference of longitude in a departure column is 59′W: hence the longitudes of yesterday by account and observation, reduced to the noon of this day, will be 14° 12′W and 13° 58′ respectively.

To find the bearing and distance of Porto Sancto.

Latitude ship -	42° 1′N.	Mer. parts -	2783	Longitude -	13° 58′W
Lat. Porto Sancto	32 58 N.	Mer. parts -	2097	Longitude -	16 25 W
Difference of latitude	9 3=543	M. D. latitude	686	D. Longitude	2 27=147.

The meridional difference of latitude and difference of longitude will be found to agree nearest under 12, the correct bearing of Porto Sancto; and the variation being allowed to the right hand of S 12°W, gives S $32\frac{1}{2}^{0}$ W, the bearing per compass; and the distance answering to the difference of latitude 543, under 12 degrees, is 555 miles.

A Journal

A Journal from England towards Madeira.

Ship's Journal.

Hours.	Kn.	Fa.	Courses.	Winds.	Remarks, ⊙ October 13. 1793.
1	8		SW*b*S	ENE	A steady gale, and fine weather.
2	8	5			
3	8	6			At 34 minutes past three, the distance between the nearest limbs of the sun and moon, together with the altitude of each, were observed; from whence the ship's longitude at that time is 14° 1′ W.
4	8				
5	8				
6	8				
7	8				Hauled in the lower studding-sails.
8	7				At 9^h 22′, by an observation of the moon's distance from α Pegasi, the longitude was 14° 20′ W.
9	7				
10	7				
11	7				Fresh gales, and clear.
12	7				
1	7			ESE	
2	8				
3	7				
4	7				Do. weather.
5	7				
6	7				
7	8				Variation per amplitude 19° 51′ W.
8	8	5			Do. per azimuth 19° 28′ W. Set studding-sails.
9	8	4			
10	8	2			Carried away a fore-top-mast-studding-sail boom, got up another.
11	8				
12	7	4			Fresh gales. Took in studding-sails.

Course.	Dist.	D.L.	Dep.	N. Latitude by Acc.	N. Latitude by Obs.	D. Long.	W. Long. by Acc.	W. Long. by Obs.	W. Var. by Obs.	Porto Sancto's Bearing.	Porto Sancto's Distance.
S*b*W$\frac{1}{4}$W	184	178	45	39° 3′		59′ W.	15° 11′	14° 52′	1$\frac{3}{4}$ pts.		

The mean of the variation is about 1$\frac{3}{4}$ points W: hence the course corrected is S*b*W$\frac{1}{4}$W; with which and the distance run 184 miles, the difference of latitude is 178.5, and the departure 44.7.

Yesterday's latitude	42° 1′N.	Mer. parts	2783
Difference of latitude	2 58 S.		
Latitude in by account	39 3 N.	Mer. parts	2549
Meridional difference of latitude			234

Now, to course 1$\frac{3}{4}$ points, and meridional difference of latitude 234, the difference of longitude is about 59 m.; which, added to the yesterday's longitude by account 14° 12′W, the sum 15° 11′W is the longitude in by account at noon. The longitudes by observation are reduced to noon as follow:

The distance run between noon and 3^h 34′ P. M. is 29 miles; to which, and the course 1$\frac{3}{4}$ points, the difference of latitude is 28′

Yesterday's latitude at noon	42° 1′N.		
Latitude at time of observation	41 33 N.	Mer. parts	2746
Latitude at noon	39 3 N.	Mer. parts	2549
Meridional difference of latitude			197

Then, to course 1$\frac{3}{4}$ points, and meridional difference of latitude 197 in a latitude column, the difference of longitude in a departure column is 49′W; which added to 14° 1′W, the longitude by observation, the sum 14° 50′W is the longitude reduced to noon.

Again, the distance run between the preceding noon and 9^h 22′ P. M. is 75 miles: hence the corresponding difference of latitude is 72.8, or 73 miles; the ship's latitude at that time is therefore 40° 48′N.

Latitude at time of observation	40° 48′ N	Mer. parts	2686
Latitude at noon	39 3 N	Mer. parts	2549
Meridional difference of latitude			137

Now, with the corrected course, and meridional difference of latitude, the difference of longitude is 34′ W; which added to 40° 20′ W, the sum is 14° 54′ W, the reduced longitude. The mean of which and the former reduced longitude is 14° 52′ W, the correct longitude.

Ship's Journal.

A Journal from England towards Madeira.

Ship's Journal.

Hours.	Kn.	Fa.	Courses.	Winds.	Remarks, ☽ October 14. 1793.
1	8		SW½S	E½S	Fresh gales and hazy, single reefed topsails.
2	7	5			
3	7	5			Got down topgallant yards.
4	7				Do. weather, and a confused swell running.
5	7	4	SSW		
6	7	1			
7	7				
8	6	5			More moderate.
9	6				
10	5			Variable	
11	5				
12	4				Do. with lightning all round the compass.
1	3				
2	3				
3	3	5	SW½S	SE½S	
4	4				Squally, with rain.
5	5				
6	4				
7	2	5			
8	2		SW	SSE	Moderate weather; out reef, and up topgallant yards.
9	3				
10	3	5			
11	4	5	WSW	S	At 11h 10′ A.M. the latitude from double altitudes of the sun was 37° 10′. Clear weather.
12	5				

Course.	Dist.	D.L.	Dep.	N. Latitude by Acc.	N. Latitude by Obs.	D. Long.	W. Long. by Acc.	W. Long. by Obs.	W. Var.	Porto Sancto's Bearing.	Porto Sancto's Distance.
S 16° W	116	111	32	37° 12′	37° 8′	41′ W.	15° 52′	15° 33′	1¾ pts.	S 10° W.	254 m.

As the the ship is close hauled from 2 o'clock A. M. 1¼ points leeway are allowed upon that course and a point on the two following courses.

Courses.	Dist.	Diff. of Lat. N.	Diff. of Lat. S.	Departure. E.	Departure. W.
S½W¼W	30		29.1		7.3
S¼W	54		53.9		2.7
SSW½W	19		16.8		9.0
SW¾S	8.5		6.8		5.1
SW½W¼W	9.5		4.9		8.1
S 16° W	116		111.5 = 1° 51′		32.2

Yesterday's latitude 39 3
Latitude in by account 37 12
} M. lat. 38° 7′

To middle latitude 38°, and departure 32.2 in a latitude column, the difference of longitude in a distance, column is 41′.

Yesterday's lon. by account 15° 11′ W. by ob. 14° 52′ W.

Difference of longitude	41 W.	41 W.
Longitude in -	15 22	15 33 W.

The latitude by observation at 11h 10′ A. M. is 37° 10′, and from that time till noon the ship has run about 4 miles. Hence the corresponding difference of latitude is two miles, which subtracted from the latitude observed, gives 37° 8′, the latitude reduced to noon.

To find the bearing and distance of Porto Sancto.

Latitude of ship -	37° 8′ N.	-	Mer. parts. 2403	-	Longitude -	15° 33′ W.	
Latitude of Port Sancto	32 58 N.	-	Mer. parts. 2097	-	Longitude -	16 25 W.	
Difference of latitude	4 10 = 250		M. D. lat. 306		Diff. longitude	52	

Hence the bearing of Port Sancto is S 10° W, or SSW¾W nearly, per compass, and the distance is 254 miles.

A Journal from England towards Madeira.

Ship's Journal.

Hours.	Kn.	Fa.	Courses.	Winds.	Remarks, 8 October 15. 1793.
1	4		W b S	S b W	Moderate and clear weather.
2	4				
3	3	6			Employed working points and rope-bands.
4	3				Ditto weather.
5	3	4			
6	3		W b N	SW b S	
7	3				
8	3	2			Fine clear weather.
9	4				
10	4				
11	3	5			
12	3	3		Variable.	Ditto weather.
1	3				
2	4		W		
3	3				
4	2		WNW		
5	2	4	NW b W	SW b W	
6	3				
7	3				Variation per mean of several azimuths 18° 0′ W.
8	3	6			Ditto weather. Tacked ship.
9	4		S b E		
10	5				Sail-makers making wind-sails.
11	5	4			
12	5	6			A fine steady breeze. Cloudy.

Course.	Dist.	D.L.	Dep.	N. Latitude by Acc.	N. Latitude by Obs.	D. Long.	W. Long. by Acc.	W. Long. by Obs.	W. Var. by Obs.	Porto Sancto's Bearing.	Porto Sancto's Distance.
S. 68° W.	56	21	52	36° 47′		65′ W.	16° 57′	16° 38′	18°	S ¼ E.	229

Half a point of leeway is allowed on each course; but as the variation is expressed in degrees, it will be more convenient and accurate to reduce the several courses into one, leeway only being allowed upon them. The course thus found is then to be corrected for variation, with which and the distance made good the difference of latitude and departure are to be found.

Courses.	Dist.	Diff. of Latitude. N.	Diff. of Latitude. S	Departure. E	Departure. W
W ½ S	18		1.8		17.9
W b N ½ N	27	7.8			25.8
W ½ N	7	0.7			7.0
NW b W ½ W	2	0.9			1.8
NW ½ W	12	7.6			9.3
S b E ½ E	20		19.1	5.8	
		17.0	20.9	5.8	61.8
			17.0		5.8
S 86° W.	56		3.9		56.0
Var. 18 W.					

Tr. cour. S 68 W. to which and the distance 56 m. the difference of latitude is 21 m. and the departure 51.9 m. Hence the latitude in at noon is 36° 47′ W, and middle latitude 36° 58′, to which and the departure 51.9 in a latitude column, the difference of longitude in distance column is 65° W.

Yesterday's long. by acc.	15° 52′ W.	By obs.	15° 33′ W.
Difference of longitude	1 5 W.		1 5 W.
Longitude in	16 57		16 38 W.

To find the bearing and distance of Porto Sancto.

Latitude ship	36° 47′ N.	Mer. parts	2376	Longitude	16° 38′ W.
Lat. of Porto Sancto	32 58 N.	Mer. parts	2097	Longitude	16 25 W.
Dist. of latitude	3 49 = 229.	M. D. Lat.	279	D. Longitude	0 13

Hence the course is S ¼ E, distance 229 miles; and the course per compass is S b W ½ W nearly.

Ship's Journal.

A Journal from England towards Madeira.

Ship's Journal.

Hours.	Kn.	Fa.	Courses.	Winds.	Remarks, ☿ October 16. 1793.
1	6		S b E	SW b W	Fresh gales.
2	6	4			
3	7		S	W	
4	7				Do. and cloudy.
5	7				
6	7	4			
7	7	6			
8	7				A steady fresh gale.
9	8		S b W	NW	
10	8				
11	8				
12	8				Do. weather.
1	8				
2	8				
3	8				
4	9				Do. weather.
5	9		S b W ½ W		
6	9			N	
7	9				Variation *per* amplitude 1½ points W.
8	8	5			
9	9				People employed occasionally.
10	9			NE b E	
11	7				
12	8				Do. weather. Observed sun's meridian altitude.

Course.	Dist.	D.L.	Dep.	N. Latit. by Acc.	N. Latit. by Obs.	D. Long.	W. Long. by Acc.	W. Long. by Obs.	W. Var. Obs.	Porto Sancto's Bearing.	Porto Sancto's Distance.
S 8° E	186	185	26	33° 42′	33° 46′	31′ E.	16° 26′	16° 7′	1½ pts.	S 17° W.	50 miles.

Half a point of leeway is allowed on the first course; which, and the others, are corrected for variation as usual.

Courses.	Dist.	Diff. of Lat. N.	Diff. of Lat. S.	Departure. E.	Departure. W.
SE b S	12.4		10.3	6.9	
S b E ½ E.	43.		41.2	12.5	
S ½ E	65.		64.7	6.4	
S	68.5		68.5		
S 8° E	18.6		184.7	25.8	
			3° 5′		

Yesterday's latitude - 36 47 N.
Latitude by account - 33 42 N.
Sum - - - - - 70 29
Middle latitude - - 35 15

To middle latitude and the departure, the difference of longitude in a distance column is 31′ E.

Yesterday's long. by acc. 16° 57′ W. by obs. 16° 38′ W.
Difference of long. 0 31 E. - 0 31 E.

Longitude in 16 26 W. 16 7 W.

To find the bearing and distance of Porto Sancto.

Latitude of ship -	33° 46′ N.	Mer. parts -	2155	Longitude -	16° 7′ W
Lat. Port Sancto -	32 58 N.	Mer. parts -	2097	Longitude -	16 25 W
Difference of latitude	48	Mer. diff. lat.	58	Diff. long. -	18

Hence the bearing of Porto Sancto is S 17° W, distance 50 miles.

A Journal

Ship's Journal.

A Journal from England towards Madeira.

Ship's Journal.

Hours.	Kn.	Fa.	Course.	Winds.	Remarks, ♄ October 17. 1793.
1	5		SSW	NE*b*E	Moderate wind and clear.
2	5				Saw the island of Porto Sancto, SW*b*S.
3	5		S		Hauled up to round the east end of Porto Sancto.
4	5				Bent the cables.
5	5				
6	6				
7	6				
8	7				Squally weather.
9	8		SW*b*W		Port Sancto SW*b*S.
10	7				
11	7		SW*b*W		
12	6				Ditto with rain. Porto Sancto NE.
1	6		SSW		The Deserters SW*b*S.
2	5				
3	6				
4	7				The Deserters WSW. 3 or 4 leagues.
5	6				
6			Various.		Hauled up round the east end of the Deserters.
7					
8			NNW		Violent squalls; clewed up at all times.
9			NW*b*N		
10					Running into Funchal Roads.
11					
12					Anchored in Funchal Roads, with the best bower in 30 fathoms black sand and mud. Brazen head E*b*S½S, Loo Rock NW, the Great Church NNE, and the southermost Deserter SE½S; off shore two-thirds of a mile. Saluted the fort with 13 guns; returned by ditto. Found here his majesty's ship Venus, and 7 English merchants.

This journal is performed by inspection agreeable to the precepts given. Other methods might have been used for the same purpose; for which the two instruments already described and explained seem well adapted. We cannot, however, omit recommending the sliding gunter, which will be found very expeditious, not only in performing a day's work, but also in resolving most other nautical problems. See *Sliding-Gunter*.

It will be found very satisfactory to lay down the ship's place on a chart at the noon of each day, and her situation with respect to the place bound to, and the nearest land, will be obvious. The bearing and distance of the intended or any other port, and other requisites, may be easily found by the chart as already explained; and indeed, every day's work may be performed on the chart; and thus the use of tables superseded.

EXPLANATION of the TABLES.

Table I. *To reduce points of the compass to degrees, and conversely.*

The two first and two last columns of this table contain the several points and quarter-points of the compass; the third column contains the corresponding number of points and quarters; and the fourth, the degrees &c. answering thereto. The manner of using this table is obvious.

Table II. *The miles and parts of a mile in a degree of longitude at every degree of latitude.*

The first column contains degrees of latitude, and the second the corresponding miles in a degree of longitude; the other columns are a continuation of the first and second. If the given latitude consists of degrees and minutes, a proportional part of the difference between the miles answering to the given and following degrees of latitude is to be subtracted from the miles answering to the given degree.

Example. Required the number of miles in a degree of longitude, in latitude 57° 9′?

The difference between the miles answering to the latitudes of 57° and 58° is 0.89.

Then as 60′ : 9′ :: 0.89 : 0.13

Miles answering to 57° 32.68

Miles answering to 57°9′ 32.55

This table may be used in Parallel and Middle Latitude Sailing.

Table III. *Of the Sun's Semidiameter.*

This table contains the angle subtended by the sun's semidiameter at the earth, for every sixth day of the year. The months and days are contained in the first column, and the semidiameter expressed in minutes and seconds in the second column. It is useful in correcting altitudes of the sun's limb, and distances between the sun's limb and the moon.

Explanation of the Tables.

TABLE IV. *Of the Refraction in Altitude.*

The refraction is necessary for correcting altitudes and distances observed at sea; it is always to be subtracted from the observed altitude, or added to the zenith distauce. This table is adapted to a mean state of the atmosphere in Britain, namely, to 29.6 inches of the barometer, and 50° of the thermometer. If the height of the mercury in these iustruments be different from the mean, a correction is necessary to reduce the tabular to the true refraction. See REFRACTION.

TABLES V. VI. *Of the Dip of the Horizon.*

The first of these tables contains the dip answering to a free or unobstructed horizon; and the numbers therein, as well as in the other table, are to be subtracted from the observed altitude when the fore-observation is used; but added, in the back-observation.

When the sun is over the land, and the ship nearer it than the visible horizon when unconfined; in this case, the sun's limb is to be brought in contact with the line of separation of the sea and land; the distance of that place from the ship is to be found by estimation or otherwise; and the dip answering thereto, and the height of eye, is to be taken from Table VI.

TABLE VII. *Of the Correction to be applied to the time of high water at full and change of the moon, to find the time of high water on any other day of the moon.*

The use of this table is fully explained at Section II. Chap. I. Book I. of this article.

TABLES VIII. IX. X. *Of the Sun's Declination*, &c.

The first of these tables contains the sun's declination, expressed in degrees, minutes, and tenths of a minute, for four successive years, namely, 1793, 1794, 1795, and 1796: and by means of Table X. may easily be reduced to a future period; observing that, after the 28th of February 1800, the declination answering to the day preceding that given is to be taken.

Ex. 1. Required the sun's declination May 1. 1816?

May 1. 1812 is four years after the same day in 1812.

Sun's declination May 1. 1812	-	15° 6′.7 N
Equation from Table X.	- -	+0 0.6
Sun's declination May 1. 1799	-	15 7.3 N

Ex. II. Required the sun's declination August 20. 1805? Explanation of the Tables.

The given year is 12 years after 1793, and the time is after the end of February 1800.

Now, Sun's dec. August 19. 1793	-	12° 34′.6
Equation from Table X. to 12 years		—0 1.9
Sun's declination August 20. 1805	-	12 32.7

The declination in Table VIII. is adapted to the meridian of Greenwich, and Table IX. is intended to reduce it to any other meridian, and to any given time of the day under that meridian. The titles at the top and bottom of this table direct when the reduction is to be added or subtracted.

TABLE XI. *Of the Right Ascensions and Declinations of Fixed Stars.*

This table coutains the right ascensions and declinations of 60 principal fixed stars, adapted to the beginning of the year 1793. Columns fourth and sixth contain the annual variation arising from the precession of the equinoxes, and the proper motion of the stars; which serves to reduce the place of a star to a period a few years after the epoch of the table with sufficient accuracy. When the place of a star is wanted, after the beginning of 1793, the variation in right ascension is additive; and that in declination is to be applied according to its sign. The contrary rule is to be used when the given time is before 1793.

Example. Required the right ascension and declination of Bellatrix, May 1. 1798?

Right ascension January 1. 1793	=	5h 14′ 3″
Variation = 3″.21 × 5$\frac{1}{3}$ y.	=	+0 0 17
Right Ascension, May 1. 1798	=	5 14 20
Declination	=	6° 8′ 53″N
Variation = 4″ × 5$\frac{1}{3}$ y.	=	+0 0 21
Declination May 1. 1798	=	6 9 14 N

The various other tables necessary in the practice of navigation are to be found in most treatises on that subject. Those used in this article are in Mackay's Treatises on the Longitude and Navigation.

TABLE

TABLE I. *To reduce Points of the Compass to Degrees, and conversely.*

North-east Quadrant.	South-east Quadrant.	Points.	D.	M.	S.	South-west Quadrant.	North-west. Quadrant.
North.	South.	0 0	0	0	0	South.	North.
N ¼ E	S ¼ E	0 ¼	2	48	45	S ¼ W	N ¼ W
N ½ E	S ½ E	0 ½	5	37	30	S ½ W	N ½ W
N ¾ E	S ¾ E	0 ¾	8	26	15	S ¾ W	N ¾ W
N *b* E	S *b* E	1 0	11	15	0	S *b* W	N *b* W
N *b* E ¼ E	S *b* E ¼ E	1 ¼	14	3	45	S *b* W ¼ W	N *b* W ¼ W
N *b* E ½ E	S *b* E ½ E	1 ½	16	52	30	S *b* W ½ W	N *b* W ½ W
N *b* E ¾ E	S *b* E ¾ E	1 ¾	19	41	15	S *b* W ¾ W	N *b* W ¾ W
NNE	SSE	2 0	22	30	0	SSW	NNW
NNE ¼ E	SSE ¼ E	2 ¼	25	18	45	SSW ¼ W	NNW ¼ W
NNE ½ E	SSE ½ E	2 ½	28	7	30	SSW ½ W	NNW ½ W
NNE ¾ E	SSE ¾ E	2 ¾	30	56	15	SSW ¾ W	NNW ¾ W
NE *b* N	SE *b* S	3 0	33	45	0	SW *b* S	NW *b* N
NE ¾ N	SE ¾ S	3 ¼	36	33	45	SW ¾ S	NW ¾ N
NE ½ N	SE ½ S	3 ½	39	22	30	SW ½ S	NW ½ N
NE ¼ N	SE ¼ S	3 ¾	42	11	15	SW ¼ S	NW ¼ N
NE	SE	4 0	45	0	0	SW	NW
NE ¼ E	SE ¼ E	4 ¼	47	48	45	SW ¼ W	NW ¼ W
NE ½ E	SE ½ E	4 ½	50	37	30	SW ½ W	NW ½ W
NE ¾ E	SE ¾ E	4 ¾	53	26	15	SW ¾ W	NW ¾ W
NE *b* E	SE *b* E	5 0	56	15	0	SW *b* W	NW *b* W
NE *b* E ¼ E	SE *b* E ¼ E	5 ¼	59	3	45	SW *b* W ¼ W	NW *b* W ¼ W
NE *b* E ½ E	SE *b* E ½ E	5 ½	61	52	30	SW *b* W ½ W	NW *b* W ½ W
NE *b* E ¾ E	SE *b* E ¾ E	5 ¾	64	41	15	SW *b* W ¾ W	NW *b* W ¾ W
ENE	ESE	6 0	67	30	0	WSW	WNW
E *b* N ¾ N	E *b* S ¾ S	6 ¼	70	18	45	W *b* S ¾ S	W *b* N ¾ N
E *b* N ½ N	E *b* S ½ S	6 ½	73	7	30	W *b* S ½ S	W *b* N ½ N
E *b* N ¼ N	E *b* S ¼ S	6 ¾	75	56	15	W *b* S ¾ S	W *b* N ¼ N
E *b* N	E *b* S	7 0	78	45	0	W *b* S	W *b* N
E ¾ N	E ¾ S	7 ¼	81	33	45	W ¾ S	W ¾ N
E ½ N	E ½ S	7 ½	84	22	30	W ½ S	W ½ N
E ¼ N	E ¼ S	7 ¾	87	11	15	W ¼ S	W ¼ N
East.	East.	8 0	90	0	0	West.	West.

TABLE II. *The Miles and Parts of a Mile in a Degree of Longitude at every Degree of Latitude.*

D. L.	Miles.	D. L.	Miles.	D. L.	Miles.	D. L.	Miles.	D. L.	Miles.	D. L.	Miles.
1	59.99	16	57.67	31	51.43	46	41.68	61	29.09	76	14.51
2	59.97	17	57.36	32	50.88	47	40.92	62	28.17	77	13.50
3	59.92	18	57.06	33	50.32	48	40.15	63	27.24	78	12.48
4	59.86	19	56.73	34	49.74	49	39.36	64	26.30	79	11.45
5	59.77	20	56.38	35	49.15	50	38.57	65	25.36	80	10.42
6	59.67	21	56.01	36	48.54	51	37.76	66	24.41	81	9.38
7	59.56	22	55.63	37	47.92	52	36.94	67	23.45	82	8.35
8	59.44	23	55.23	38	47.28	53	36.11	68	22.48	83	7.32
9	59.26	24	54.81	39	46.62	54	35.26	69	21.50	84	6.28
10	59.08	25	54.38	40	45.95	55	4.41	70	20.52	85	5.23
11	58.89	26	53.93	41	45.28	56	33.55	71	19.54	86	4.18
12	58.68	27	53.46	42	44.95	57	32.68	72	18.54	87	3.14
13	58.46	28	52.97	43	43.88	58	31 79	73	17.54	88	2.09
14	58.22	29	52.47	44	43.16	59	30.90	74	16.53	89	1.05
15	57.95	30	51.96	45	42.43	60	30.00	75	15.52	90	0.00

TABLE III. *Sun's Semidia.*

Mon.	Day.	Sun's Semidiam.	
January.	1	16′	19
	7	16	19
	13	16	19
	19	16	18
	25	16	17
February.	1	16	16
	17	16	15
	13	16	14
	19	16	13
	25	16	12
March.	1	16	10
	7	16	9
	13	16	7
	19	16	6
	25	16	4
April.	1	16	2
	7	16	1
	13	15	59
	19	15	57
	25	15	56
May	1	15	54
	7	15	53
	13	15	52
	19	15	51
	25	15	50
June	1	15	49
	7	15	48
	13	15	47
	19	15	47
	25	15	47
July.	1	15	47
	7	15	47
	13	15	47
	19	15	48
	25	15	48
August.	1	15	49
	7	15	50
	13	15	51
	19	15	52
	25	15	53
September.	1	15	55
	7	15	56
	13	15	58
	19	15	59
	25	16	1
October.	1	16	3
	7	16	4
	13	16	6
	19	16	8
	25	16	9
November.	1	16	11
	7	16	13
	13	16	14
	19	16	15
	25	16	16
December.	1	16	17
	7	16	18
	13	16	18
	19	16	19
	25	16	19

TABLE IV.
Refraction in Altitude.

App. Alt.	Refrac.	App. Alt.	Refrac.	App. Alt.	Refrac.
D. M.	M. S.	D. M.	M. S.	D.	M. S.
0 0	33 0	6 30	7 51	30	1 38
0 5	32 10	6 40	7 40	31	1 35
0 10	31 22	6 50	7 30	32	1 31
0 15	30 35	7 0	7 20	33	1 28
0 20	29 50	7 10	7 11	34	1 24
0 25	29 6	7 20	7 2	35	1 21
0 30	28 22	7 30	6 53	36	1 18
0 35	27 41	7 40	6 45	37	1 16
0 40	27 0	7 50	6 37	38	1 13
0 45	26 20	8 0	6 29	39	1 10
0 50	25 42	8 10	6 22	40	1 8
0 55	25 5	8 20	6 15	41	1 5
1 0	24 49	8 30	6 8	42	1 3
1 5	23 54	8 40	6 1	43	1 1
1 10	23 20	8 50	5 55	44	0 59
1 15	22 47	9 0	5 48	45	0 57
1 20	22 15	9 10	5 42	46	0 55
1 25	21 44	9 20	5 36	47	0 53
1 30	21 15	9 30	5 31	48	0 51
1 35	20 46	9 40	5 25	49	0 49
1 40	20 18	9 50	5 20	50	0 48
1 45	19 51	10 0	5 15	51	0 46
1 50	19 25	10 15	5 7	52	0 44
1 55	19 0	10 30	5 0	53	0 43
2 0	18 35	10 45	4 53	54	0 41
2 5	18 11	11 0	4 47	55	0 40
2 10	17 48	11 15	4 40	56	0 38
2 15	17 26	11 30	4 34	57	0 37
2 20	17 4	11 45	4 29	58	0 35
2 25	16 44	12 0	4 23	59	0 34
2 30	16 24	12 20	4 16	60	0 33
2 35	16 4	12 40	4 9	61	0 32
2 40	15 45	13 0	4 3	62	0 30
2 45	15 27	13 20	3 57	63	0 29
2 50	15 9	13 40	3 51	64	0 28
2 55	14 52	14 0	3 45	65	0 26
3 0	14 36	14 20	3 40	66	0 25
3 5	14 20	14 40	3 35	67	0 24
3 10	14 4	15 0	3 30	68	0 23
3 15	13 49	15 30	3 24	69	0 22
3 20	13 34	16 0	3 17	70	0 21
3 25	13 20	16 30	3 10	71	0 19
3 30	13 6	17 0	3 4	72	0 18
3 40	12 40	17 30	2 59	73	0 17
3 50	12 15	18 0	2 54	74	0 16
4 0	11 51	18 30	2 49	75	0 15
4 10	11 29	19 0	2 44	76	0 14
4 20	11 8	19 30	2 39	77	0 13
4 30	10 48	20 0	2 35	78	0 12
4 40	10 29	20 30	2 31	79	0 11
4 50	10 11	21 0	2 27	80	0 10
5 0	9 54	21 30	2 24	81	0 9
5 10	9 38	22 0	2 20	82	0 8
5 20	9 23	23 0	2 14	83	0 7
5 30	9 8	24 0	2 7	84	0 6
5 40	8 54	25 0	2 2	85	0 5
5 50	8 41	26 0	1 56	86	0 4
6 0	8 28	27 0	1 51	87	0 3
6 10	8 15	28 0	1 47	88	0 2
6 20	8 3	29 0	1 42	89	0 1

TABLE V.
Dip of the Horizon.

Height of eye.	Dip of Horizon.	Height of eye.	Dip of Horizon.	Height of eye.	Dip of Horizon.	Height of eye.	Dip of Horizon.
Feet.	M. S.	Feet.	M. S.	Feet.	M. S.	Feet.	M. S.
1	0 57	11	3 10	21	4 22	35	5 39
2	1 21	12	3 18	22	4 28	40	6 2
3	1 39	13	3 26	23	4 34	45	6 24
4	1 55	14	3 34	24	4 40	50	6 44
5	2 8	15	3 42	25	4 46	55	7 4
6	2 20	16	3 49	26	4 52	60	7 23
7	2 31	17	3 56	27	4 58	70	7 59
8	2 42	18	4 3	28	5 3	80	8 32
9	2 52	19	4 10	29	5 9	90	9 3
10	3 1	20	4 16	30	5 14	100	9 33

TABLE VI.
Dip of the Sea at different distances from the Observer.

Dist. of land in sea miles.	Height of the eye above the sea in feet.							
	5	10	15	20	25	30	35	40
	Dip.	Dip.	Dip.	Dip.	Dip.	Dip.	Dip.	Dip.
	M.	M	M.	M	M.	M.	M.	M.
0	11	22	34	45	56	68	79	90
0 ¼	6	11	17	22	28	34	39	45
0 ½	4	8	12	15	19	23	27	30
0 ¾	4	6	9	12	15	17	20	23
1 0	3	5	7	9	12	14	16	19
1 ¼	3	4	6	8	10	11	14	15
1 ½	2	3	5	6	8	10	11	12
2 0	2	3	5	6	7	8	9	10
2 ½	2	3	4	5	6	7	8	8
3 0	2	3	4	5	6	6	7	7
3 ½	2	3	4	4	5	6	7	7
4 0	2	3	4	4	5	5	6	6
5 0	2	3	4	4	5	5	6	6
6 0								

TABLE VII.
The Correction to be applied to the time of High-water at Full and Change of the Moon, to find the time of High-water on any other day.

Interval of Time.	After New or Full Moon.	Before 1st or 3d Quarter.	After 1st or 3d Quarter.	Before New or Full Moon
	Additive.	Additive.	Additive.	Subtractive
D. H.	H. M.	H. M	H. M.	H M
0 0	0 0	5 6	5 6	0 0
0 6	0 8	4 51	5 22	0 9
1 12	0 17	4 37	5 40	0 18
0 18	0 26	4 23	6 0	0 27
1 0	0 36	4 9	6 20	0 37
1 6	0 45	3 56	6 39	0 47
1 12	0 54	3 44	6 58	0 57
1 18	1 2	3 32	7 18	1 7
2 0	1 11	3 21	7 37	1 17
2 6	1 19	3 11	7 56	1 28
2 12	1 28	3 1	8 14	1 39
2 18	1 37	2 50	8 31	1 51
3 0	1 46	2 40	8 47	2 4
3 6	1 54	2 30	9 2	2 16
3 12	2 3	2 21	9 17	2 29
3 18	2 12	2 12	9 31	2 44
4 0	2 21	2 3	9 44	2 58

TABLE VIII. *Sun's Declination for* 1809, *being the first after leap year.*

Days	January.	February.	March.	April.	May	June.	July.	August.	September.	October.	November	December
1	23° 1'6 S	17° 7'5 S	7° 37'1 S	4° 29'7N	15° 2'0N	22° 2'5N	23° 8'8N	18° 5'7N	8° 21'9N	3° 7'4 S	14° 24'3 S	21° 48'7S.
2	22 56.4	16 50.3	7 14.3	4 52.8	15 20.0	22 10.6	23 4.7	17 50.5	8 0.0	3 30.7	14 43.5	21 57.9
3	22 50.8	16 32.8	6 51.4	5 15.8	15 37.9	22 18.3	23 0.1	17 35.0	7 38.1	3 54.0	15 2.4	22 6.6
4	22 44.7	16 15.0	6 28.4	5 38.7	15 55.4	22 25.6	22 55.2	17 19.2	7 16.0	4 17.3	15 21.1	22 14.9
5	22 38.2	15 59.9	6 1.5	6 1.5	16 12.7	22 32.4	22 49.9	17 3.2	6 53.8	4 40.4	15 39.6	22 22.8
6	22 31.2	15 38.6	5 42.0	6 24.2	16 29.7	22 38.9	22 44.1	16 46.8	6 31.4	5 3.6	15 57.7	22 30.3
7	22 23.8	15 19.9	5 18.8	6 46.8	16 46.5	22 45.0	22 38.0	16 30.2	6 9.0	5 26.7	16 15.7	22 37.3
8	22 15.9	15 1.1	4 55.4	7 9.3	17 2.9	22 50.7	22 31.5	16 13.3	5 46.4	5 49.7	16 33.3	22 43.9
9	22 7.6	14 41.9	4 32.0	7 31.7	17 19.1	22 56.0	22 24.6	15 56.2	5 23.8	6 12.6	16 50.7	22 50.0
10	21 58.9	14 22.6	4 8.6	7 53.9	17 35.0	23 0.9	22 17.3	15 38.8	5 1.0	6 35.4	17 7.8	22 55.7
11	21 49.7	14 2.9	3 45.0	8 16.0	17 50.6	23 5.3	22 9.6	15 21.2	4 38.2	6 58.2	17 24.6	23 0.9
12	21 40.1	13 43.1	3 21.5	8 38.0	18 5.9	23 9.4	22 1.5	15 3.3	4 15.3	7 20.9	17 41.0	23 5.6
13	21 30.1	13 23.0	2 57.9	8 59.9	18 20.9	23 13.1	21 53.0	14 45.1	3 52.3	7 43.4	17 57.2	23 10.0
14	21 19.7	13 2.7	2 34.2	9 21.6	18 35.6	23 16.4	21 44.2	14 26.7	3 29.3	8 5.9	18 13.1	23 13.8
15	21 8.9	12 42.3	2 10.6	9 43.1	18 50.0	23 19.2	21 35.0	14 8.1	3 6.2	8 28.2	18 28.6	23 17.2
16	20 57.6	12 21.5	1 46.9	10 4.5	19 4.1	23 21.7	21 25.4	13 49.3	2 43.0	8 50.4	18 43.9	23 20.0
17	20 46.0	12 0.6	1 23.2	10 25.7	19 17.9	23 23.7	21 15.5	13 30.3	2 19.8	9 12.5	18 58.7	23 22.5
18	20 33.9	11 39.6	0 59.5	10 46.7	19 31.3	23 25.3	21 5.3	13 11.0	1 56.6	9 34.5	19 13.3	23 24.5
19	20 21.5	11 18.3	0 35.7	11 7.5	19 44.4	23 26.5	20 54.6	12 51.5	1 33.3	9 56.3	19 27.5	23 26.0
20	20 8.7	10 56.9	0 12.0	11 28.3	19 57.1	23 27.3	20 43.6	12 31.9	1 10.0	10 18.0	19 41.3	23 27.0
21	19 55.5	10 35.2	0 11.6N	11 48.8	20 9.5	23 27.7	20 32.3	12 12.0	0 46.6	10 39.5	19 54.8	23 27.6
22	19 42.0	10 13.5	0 35.3	12 9.0	20 21.6	23 27.7	20 20.6	11 51.9	0 23.2	11 0.9	20 7.9	23 27.7
23	19 28.0	9 51.5	0 58.9	12 29.1	20 33.3	23 27.2	20 8.5	11 31.7	0 0.2 S	11 20.0	20 29.7	23 27.3
24	19 13.8	9 29.5	1 22.5	12 49.0	20 44.7	23 26.3	19 56.2	11 11.3	0 23.6	11 43.0	20 33.0	23 26.4
25	18 59.2	9 7.3	1 46.1	13 8.7	20 55.7	23 25.0	19 43.5	10 50.7	0 47.0	12 3.9	20 45.0	23 25.1
26	18 44.2	8 44.9	2 9.7	13 28.2	21 6.4	23 23.4	19 30.5	10 29.9	1 10.4	12 24.6	20 56.6	23 23.3
27	18 28.9	8 22.4	2 33.2	13 47.4	21 16.7	23 21.3	19 17.1	10 9.0	1 33.9	12 45.0	21 7.9	23 21.0
28	18 13.2	7 59.8	2 56.6	14 6.4	21 26.6	23 18.8	19 3.4	9 47.9	1 57.3	13 5.3	21 18.7	23 18.3
29	17 57.3		3 20.0	14 25.2	21 36.1	23 15.9	18 49.5	9 26.6	2 20.7	13 25.4	21 29.1	23 15.1
30	17 41.0		3 43.3	14 43.7	21 45.3	23 12.5	18 35.2	9 5.2	2 44.0	13 45.2	21 39.1	23 11.5
31	17 24.4		4 6.5		21 54.1		18 20.6	8 43.6		14 4.9		23 7.3

TABLE VIII. *The Sun's Declination for* 1810, *being the second after leap year.*

Days	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1	23° 2'7S.	17° 1'6S.	7° 42'7S.	4° 24'0N	14° 57'5N	22° 0'5N	23° 9'7N	18° 9'3N	8° 27'1N	3° 1'8S.	14° 19'6S.	21° 46'4S.
2	22 57.7	16 54.5	7 19.6	4 47.1	15 15.6	22 8.6	23 5.7	17 54.2	8 5.3	3 25.1	14 38.8	21 55.7
3	22 52.1	16 37.0	6 57.0	5 10.1	15 33.5	22 16.4	23 1.3	17 38.7	7 43.4	3 48.4	14 57.8	22 4.5
4	22 46.2	16 19.3	6 34.0	5 33.1	15 51.1	22 23.7	22 56.4	17 23.0	7 21.3	4 11.7	15 16.6	22 12.9
5	22 39.7	16 1.3	6 10.9	5 55.9	16 8.5	22 30.7	22 51.2	17 7.0	6 59.1	4 34.9	15 35.1	22 20.9
6	22 32.9	15 43.0	5 47.7	6 18.7	16 25.6	22 37.3	22 45.5	16 50.7	6 36.8	4 58.0	15 53.3	22 28.5
7	22 25.6	15 24.4	5 24.5	6 41.3	16 42.4	22 43.5	22 39.5	16 34.2	6 14.4	5 21.1	16 11.3	22 35.6
8	22 17.8	15 5.6	5 1.1	7 3.9	16 58.9	22 49.3	22 33.0	16 17.4	5 51.9	5 44.1	16 29.0	22 42.3
9	22 9.6	14 46.5	4 37.7	7 26.3	17 15.2	22 54.7	22 26.7	16 0.3	5 29.3	6 7.0	16 46.5	22 48.5
10	22 1.0	14 27.2	4 14.2	7 48.5	17 31.1	22 59.7	22 19.0	15 43.0	5 6.6	6 29.9	17 3.6	22 54.3
11	21 51.9	14 7.7	3 50.7	8 10.7	17 46.8	23 4.3	22 11.4	15 25.4	4 43.8	6 52.6	17 20.4	22 59.6
12	21 42.6	13 47.9	3 27.2	8 32.7	18 2.2	23 8.4	22 3.5	15 4.7	4 20.9	7 15.3	17 37.0	23 4.5
13	21 32.5	13 27.9	3 3.6	8 54.5	18 17.3	23 12.2	21 55.1	14 49.5	3 58.0	7 37.9	17 53.2	23 8.9
14	21 22.2	13 7.7	2 40.0	9 16.3	18 32.0	23 15.6	21 46.4	14 31.2	3 35.0	8 0.4	18 9.2	23 12.9
15	21 11.5	12 47.2	2 16.3	9 37.8	18 46.5	23 18.5	21 37.3	14 12.7	3 11.9	8 22.7	18 24.8	23 16.4
16	21 0.3	12 26.6	1 52.7	9 59.2	19 0.6	23 21.1	21 27.8	13 53.9	2 48.8	8 44.9	18 40.1	23 19.4
17	20 48.8	12 5.8	1 29.0	10 20.4	19 14.5	23 23.2	21 18.0	13 35.0	2 25.6	9 7.0	18 55.0	23 21.9
18	20 36.9	11 44.7	1 5.3	10 41.5	19 28.0	23 24.9	21 7.8	13 15.8	2 2.3	9 29.0	19 9.7	23 24.0
19	20 24.5	11 23.5	0 41.6	11 2.4	19 41.1	23 26.2	20 57.3	12 56.3	1 39.1	9 50.9	19 24.0	23 25.6
20	20 11.8	11 2.1	0 18.0	11 23.1	19 54.0	23 27.1	20 46.3	12 36.7	1 15.7	10 12.6	19 37.9	23 26.8
21	19 58.7	10 40.6	0 5.7	11 43.6	20 6.4	23 27.6	20 35.1	12 16.9	0 52.4	10 34.2	19 51.5	23 27.5
22	19 45.3	10 18.9	0 29.3	12 4.0	20 18.6	23 27.7	20 23.5	12 56.9	0 29.0	10 55.6	20 4.7	23 27.7
23	19 31.5	9 57.0	0 53.0	12 24.1	20 30.4	23 27.3	20 11.5	11 36.7	0 5.6	11 16.8	20 17.5	23 27.4
24	19 17.3	9 34.9	1 16.7	12 44.0	20 41.9	23 26.5	19 59.3	11 16.3	0 17.8S.	11 37.9	20 30.0	23 26.7
25	19 2.8	9 12.8	1 40.2	13 3.7	20 53.0	23 25.4	19 46.6	10 55.7	0 41.3	11 58.8	20 42.1	23 25.5
26	18 47.9	8 50.5	2 3.8	13 23.3	21 3.7	23 23.8	19 33.7	10 35.0	1 4.7	12 19.5	20 53.8	23 23.8
27	18 32.5	8 28.0	2 27.3	13 42.6	21 14.1	23 21.8	19 20.3	10 14.0	1 28.2	12 40.0	21 5.1	23 21.5
28	18 17.1	8 5.4	2 50.7	14 1.6	21 24.1	23 19.4	19 6.8	9 53.0	1 51.6	13 0.4	21 16.0	23 19.0
29	18 1.2		3 14.2	14 20.5	21 33.8	23 16.6	18 52.9	9 31.7	2 15.0	13 20.5	21 26.6	23 15.9
30	17 45.0		3 37.5	14 39.1	21 43.0	23 13.4	18 38.7	9 10.3	2 38.4	13 30.4	21 36.7	23 12.4
31	17 28.5		4 0.7		21 52.0		18 24.1	8 48.8		14 0.1		23 8.4

TABLE VIII. *Sun's declination for* 1811, *being the third after leap year.*

Days.	January	February	March.	April.	May	June.	July.	August.	September	October.	November.	December.
1	23° 3'9S.	17° 15'7S.	7° 48'2S.	4° 18'4N	14° 53'1N	21° 58'5N	23° 10'6N	18° 12'8S.	8° 32'3S.	2° 56'1S.	14° 14'8S.	21° 44'0S.
2	22 58.9	16 58.6	7 25.4	4 41.5	15 11.3	22 6.7	23 6.7	17 57.8	8 10.6	3 19.4	14 34.1	21 53.4
3	22 53.5	16 41.3	7 2.6	5 4.6	15 29.2	22 14.6	23 2.3	17 42.4	7 48.7	3 42.7	14 53.1	22 2.3
4	22 47.7	16 23.6	6 39.6	5 27.5	15 46.9	22 22.0	22 57.6	17 26.8	7 26.6	4 5.9	15 11.9	22 10.9
5	22 41.3	15 5.7	6 16.5	5 50.4	16 4.3	22 29.1	22 52.4	17 10.9	7 4.5	4 29.2	15 30.5	22 18.9
6	22 34.6	15 47.5	5 53.4	6 13.1	16 21.4	22 35.8	22 46.9	16 54.7	6 42.2	4 52.3	15 48.8	22 26.6
7	22 27.4	15 29.0	5 30.1	6 35.8	16 38.3	22 42.0	22 41.0	16 38.2	6 19.9	5 15.4	16 6.9	22 33.9
8	22 19.7	15 10.3	5 6.8	6 58.3	16 54.9	22 47.9	22 34.6	16 21.5	5 57.4	5 38.4	16 24.6	22 40.7
9	22 11.6	14 51.3	4 43.5	7 20.7	17 11.2	22 53.4	22 27.9	16 4.5	5 34.8	6 1.3	16 42.1	22 47.0
10	22 3.1	14 32.0	4 20.4	7 43.0	17 27.3	22 58.5	22 20.8	15 47.2	5 12.1	6 24.2	16 59.3	22 52.9
11	21° 54.2	14 12.5	3 56.5	8 5.2	17 43.0	23 3.2	22 13.3	15 29.7	4 49.3	6 47.0	17 16.3	22 58.3
12	21 44.8	13 52.8	3 33.0	8 27.3	17 58.4	23 7.4	22 5.4	15 11.9	4 26.5	7 9.7	17 32.9	23 3.3
13	21 35.0	13 32.9	3 9.5	8 49.2	18 13.6	23 11.3	21 57.2	14 53.9	4 3.5	7 32.3	17 49.3	23 7.9
14	21 24.8	13 12.7	3 45.9	9 10.9	18 28.5	23 14.8	21 48.5	14 35.6	3 40.6	7 54.9	18 5.3	23 11.9
15	21 14.1	12 52.3	2 22.2	9 32.5	18 43.0	23 17.9	21 39.5	14 17.2	3 17.5	8 17.3	18 21.0	23 15.5
16	21 3.1	12 31.7	1 58.6	9 54.0	18 57.2	23 20.5	21 30.1	13 58.5	2 54.3	8 39.5	18 36.4	23 18.7
17	20 51.7	12 10.9	1 34.9	10 15.3	19 11.1	23 22.7	21 20.4	13 39.5	2 31.2	9 1.7	18 51.4	23 21.3
18	20 39.9	11 49.9	1 11.2	10 36.4	19 24.7	23 24.5	21 10.3	13 20.3	2 7.9	9 23.7	19 6.1	23 23.5
19	20 27.9	11 28.8	0 47.5	10 57.3	19 37.9	23 25.9	20 59.8	13 1.0	1 44.6	9 45.6	19 20.5	23 25.3
20	20 15.0	11 7.4	0 23.8	11 18.1	19 50.9	23 26.9	20 48.9	12 41.4	1 21.3	10 7.4	19 34.5	23 26.5
21	20 0.0	10 45.9	0 0.0	11 38.7	20 3.5	23 27.5	20 37.8	12 21.6	0 57.9	10 29.0	19 48.2	23 27.4
22	19 48.6	10 24.2	0 23.6N	11 59.0	20 15.7	23 27.7	20 26.2	12 1.6	0 34.5	10 50.4	20 1.5	23 27.7
23	19 34.9	10 2.3	0 47.2	12 19.3	20 27.6	23 27.4	20 14.4	11 41.5	0 11.1	11 11.7	20 14.4	23 27.5
24	19 20.8	9 40.3	1 10.9	12 39.3	20 39.2	23 26.8	20 2.2	11 21.1	0 12.3S.	11 32.8	20 27.1	23 26.9
25	19 6.3	9 18.1	1 34.5	12 59.0	20 50.4	23 25.7	19 49.6	11 0.6	0 35.7	11 53.8	20 39.2	23 25.8
26	18 51.5	8 55.8	2 58.0	13 18.6	21 1.2	23 24.2	19 36.7	10 39.9	0 59.1	12 14.5	20 51.0	23 24.2
27	18 36.3	8 33.4	2 21.6	13 38.0	21 11.7	23 22.2	19 23.5	10 19.0	1 22.5	12 35.0	21 2.4	23 22.2
28	18 20.9	8 10.9	2 45.1	13 57.1	21 21.8	23 20.0	19 10.0	9 58.0	1 45.9	12 55.4	21 13.4	23 19.7
29	18 5.0		3 8.5	14 16.0	21 31.5	23 17.3	18 56.2	9 36.8	2 9.3	13 15.6	21 24.0	23 16.7
30	17 48.9		3 31.9	14 34.7	21 40.9	23 14.2	18 42.0	9 15.5	2 32.7	13 55.5	21 39.2	23 13.3
31	17 32.5		3 55.2		21 49.9		18 27.6	8 54.0			23 9.4	23 9.4

TABLE VIII. *Sun's Declination for* 1812, *being leap year.*

Days.	January.	February.	March.	April.	May	June.	July.	August.	September.	October.	November.	December.
1	23 4'9S.	17° 19'8S.	7 31'0S.	4° 35'7N	15° 6'7N	22° 4'6N	23° 7'6N	18° 1'5N	8° 15'9N	3 13'7S.	14 29'3S.	21° 51'0S.
2	23 0.0	17 2.8	7 8.2	4 58.8	15 24.7	22 12.5	23 3.3	17 46.2	7 54.0	3 37.0	14 48.5	22 0.1
3	22 54.8	16 45.5	6 45.3	5 21.8	15 42.4	22 20.1	22 58.7	17 30.6	7 32.0	4 0.3	15 7.4	22 8.7
4	22 49.0	16 27.9	6 22.2	5 44.7	15 59.9	22 27.3	22 53.6	17 14.7	7 9.9	4 23.5	15 26.0	22 17.0
5	22 42.9	16 10.1	5 59.1	6 7.5	16 17.1	22 34.0	22 48.2	16 58.6	6 47.7	4 46.7	15 44.4	22 24.7
6	22 36.2	15 51.9	5 35.9	6 30.2	16 34.0	22 40.4	22 42.3	16 42.2	6 25.3	5 9.8	16 2.5	22 32.0
7	22 29.1	15 33.5	5 12.6	6 52.8	16 50.8	22 46.4	22 36.1	16 25.5	6 2.8	5 32.9	16 20.3	22 39.0
8	22 21.6	15 14.8	4 49.2	7 15.2	17 7.2	22 52.0	22 29.5	16 8.6	5 40.3	5 55.8	16 37.9	22 45.4
9	22 13.6	14 55.9	4 25.8	7 37.6	17 23.3	22 57.2	22 22.4	15 51.4	5 17.6	6 18.7	16 55.2	22 51.4
10	22 5.2	14 36.5	4 2.3	7 59.8	17 39.1	23 2.0	22 15.0	15 33.9	4 54.8	6 41.5	17 12.2	22 57.0
11	21 56.3	14 17.3	3 38.8	8 21.9	17 54.6	23 6.3	22 7.3	15 16.2	4 32.0	7 4.3	17 28.9	23 2.0
12	21 47.0	13 57.6	3 15.2	8 43.8	18 9.9	23 10.3	21 59.0	14 58.2	4 9.1	7 26.9	17 45.3	23 6.7
13	21 37.3	13 37.7	2 51.6	9 5.6	18 24.8	23 13.9	21 50.5	14 40.0	3 46.1	7 49.4	18 1.4	23 10.9
14	21 27.2	13 17.5	2 27.9	9 27.3	18 39.4	23 17.0	21 41.6	14 21.6	3 23.0	8 11.8	18 17.2	23 14.6
15	21 16.7	12 57.2	2 4.3	9 48.8	18 53.7	23 19.7	21 32.3	14 2.9	2 59.9	8 34.1	18 32.6	23 17.8
16	21 5.7	12 36.7	1 40.6	10 10.1	19 7.7	23 22.1	21 22.7	13 44.0	2 36.8	8 56.3	18 47.7	23 20.6
17	20 54.4	12 15.9	1 16.9	10 31.3	19 21.3	23 24.0	21 12.6	13 25.0	2 13.6	9 18.4	19 2.5	23 23.0
18	20 42.6	11 55.0	0 53.2	10 52.2	19 34.7	23 26.5	21 2.3	13 5.7	1 50.3	9 40.3	19 17.0	23 24.8
19	20 30.5	11 33.8	0 29.5	11 13.0	19 47.7	23 26.6	20 51.5	12 46.2	1 27.0	10 2.0	19 31.0	23 26.2
20	20 18.0	11 12.5	0 5.8	11 33.6	20 0.3	23 27.3	20 40.4	12 26.4	1 3.7	10 23.7	19 44.8	23 27.1
21	20 5.0	10 51.0	0 17.9N	11 54.0	20 12.7	23 27.6	20 29.0	12 6.5	0 40.3	10 45.1	19 58 2	23 27.5
22	19 51.8	10 29.4	0 41.5	12 14.3	20 24.6	23 27.4	20 17.2	11 46.4	0 16.9	11 6.4	20 11.2	23 27.5
23	19 38.2	10 7.6	1 5.2	12 34.3	20 36.3	23 26.9	20 5.1	11 26.1	0 6.5	11 27.6	20 23.9	23 27.0
24	19 24.1	9 45.6	1 28.8	12 54.2	20 47.5	23 25.9	19 52.7	11 5.7	0 29.9	11 48.6	20 36.1	23 26.0
25	19 9.8	9 23.5	1 52.3	13 13.8	20 58.4	23 24.5	19 39.9	10 45.0	0 53.3	12 9.4	20 48.0	23 24.5
26	18 55.0	9 1.3	2 15.8	13 33.2	21 9.0	23 22.7	19 26.8	10 24.2	1 16.7	12 30.0	20 59.5	23 22.6
27	18 40.0	8 38.9	2 39.3	13 52.3	21 19.2	23 20.5	19 13.3	10 3.2	1 40.1	12 50.4	21 10.6	23 20.3
28	18 24.6	8 16.4	3 2.7	14 11.3	21 29.0	23 17.9	18 59.6	9 42.0	2 3.5	13 10.6	21 21.4	23 17.4
29	18 8.9	7 53.8	3 26.1	14 30.0	21 38.5	23 14.8	18 45.5	9 20.7	2 26.9	13 30.6	21 31.7	23 14.0
30	17 52.9		3 49.4	14 48.5	21 47.6	23 11.4	18 31.1	8 59.3	2 50.3	13 50.4	21 41.6	23 10.3
31	17 36.5		4 12.6		21 56.3		18 16.4	8 37.7		14 10.0		23 6.0

TABLE

TABLE IX. *To reduce the Sun's Declination to any other Meridian, and to any given Time under that Meridian.*

Add in W. / Sub. in E.	Sub. in W / Add in E.	LONGITUDE.																	Add in W. / Sub. in E.	Sub. in W / Add in E.
		10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°	130°	140°	150°	160°	170°	180°	
December.	December.	0'0	0'0	0'0	0'0	0'0	0'0	0'0	0'0	0'0	0'0	0'0	0'0	0'0	0'0	0'0	0'0	0'0	0'0	June.
21	21	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	21
20	22	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	20
19	23	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	19
18	24	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.4	0.6	0.6	0.6	18
17	25	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	17
16	26	0.1	0.1	0.2	0.2	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.8	0.9	1.0	1.0	1.1	16
15	27	0.1	0.1	0.2	0.3	0.4	0.4	0.5	0.6	0.7	0.8	0.8	0.9	0.9	1.0	1.1	1.2	1.2	1.3	15
14	28	0.1	0.2	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.9	1.0	1.1	1.2	1.3	1.4	1.4	1.5	14
13	29	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	13
12	30	0.1	0.2	0.3	0.4	0.5	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.9	2.0	12
11	31	0.1	0.2	0.4	0.5	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.5	1.6	1.7	1.8	1.9	2.1	2.2	11
10	1	0.1	0.3	0.4	0.5	0.7	0.8	0.9	1.1	1.2	1.3	1.5	1.6	1.7	1.9	2.0	2.1	2.3	2.4	10
9	2	0.1	0.3	0.4	0.6	0.7	0.9	1.0	1.2	1.3	1.5	1.6	1.8	1.9	2.0	2.2	2.3	2.5	2.6	9
8	3	0.1	0.3	0.5	0.6	0.8	0.9	1.1	1.3	1.4	1.6	1.7	1.9	2.1	2.2	2.4	2.5	2.7	2.8	8
7	4	0.2	0.3	0.5	0.7	0.8	1.0	1.2	1.4	1.5	1.7	1.9	2.0	2.2	2.4	2.6	2.7	2.9	3.1	7
6	5	0.2	0.4	0.5	0.7	0.9	1.1	1.3	1.4	1.6	1.8	2.0	2.2	2.4	2.5	2.7	2.9	3.1	3.3	6
5	6	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.5	1.7	1.9	2.1	2.3	2.5	2.7	2.9	3.1	3.3	3.5	5
4	7	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.3	2.5	2.7	2.9	3.1	3.3	3.5	3.7	4
3	8	0.2	0.4	0.6	0.9	1.1	1.3	1.5	1.7	1.9	2.2	2.4	2.6	2.8	3.0	3.2	3.5	3.7	3.9	3
2	9	0.2	0.4	0.7	0.9	1.1	1.4	1.6	1.8	2.0	2.3	2.5	2.7	3.0	3.2	3.4	3.6	3.9	4.1	2
1	10	0.2	0.5	0.7	0.9	1.2	1.4	1.7	1.9	2.1	2.4	2.6	2.9	3.1	3.3	3.6	3.8	4.1	4.3	1
30	11	0.2	0.5	0.7	1.0	1.2	1.5	1.7	2.0	2.2	2.5	2.7	3.0	3.2	3.5	3.7	4.0	4.2	4.5	31
29	12	0.3	0.5	0.8	1.0	1.3	1.6	1.8	2.1	2.3	2.6	2.9	3.1	3.4	3.6	3.9	4.2	4.4	4.7	30
28	13	0.3	0.5	0.8	1.1	1.4	1.6	1.9	2.2	2.4	2.7	3.0	3.3	3.5	3.8	4.1	4.3	4.6	4.9	29
27	14	0.3	0.6	0.8	1.1	1.4	1.7	2.0	2.3	2.5	2.8	3.1	3.4	3.7	4.0	4.2	4.5	4.8	5.1	28
26	15	0.3	0.6	0.9	1.2	1.5	1.8	2.0	2.3	2.6	2.9	3.2	3.5	3.8	4.1	4.4	4.7	5.0	5.3	27
25	16	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.3	3.6	3.9	4.3	4.6	4.9	5.2	5.5	26
24	17	0.3	0.6	0.9	1.3	1.6	1.9	2.2	2.5	2.8	3.1	3.5	3.8	4.1	4.4	4.7	5.0	5.3	5.7	25
23	18	0.3	0.6	1.0	1.3	1.6	1.9	2.3	2.6	2.9	3.2	3.6	3.9	4.2	4.5	4.9	5.2	5.5	5.8	24
22	19	0.3	0.7	1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.3	3.7	4.1	4.3	4.7	5.0	5.4	5.7	6.0	23
21	20	0.3	0.7	1.0	1.4	1.7	2.1	2.4	2.8	3.1	3.4	3.8	4.1	4.5	4.8	5.2	5.5	5.9	6.2	22
20	21	0.4	0.7	1.1	1.4	1.8	2.1	2.5	2.8	3.2	3.5	3.9	4.3	4.6	5.0	5.3	5.7	6.0	6.4	21
19	22	0.4	0.7	1.1	1.5	1.8	2.1	2.5	2.9	3.3	3.6	4.0	4.4	4.7	5.1	5.5	5.8	6.2	6.6	20
18	23	0.4	0.7	1.1	1.5	1.9	2.2	2.6	3.0	3.4	3.7	4.1	4.5	4.9	5.2	5.6	6.0	6.4	6.7	19
17	24	0.4	0.8	1.1	1.5	1.9	2.3	2.7	3.1	3.4	3.8	4.2	4.6	5.0	5.4	5.7	6.1	6.5	6.9	18
16	25	0.4	0.8	1.2	1.6	2.0	2.3	2.7	3.1	3.5	3.9	4.3	4.7	5.1	5.5	5.9	6.3	6.7	7.1	17
15	26	0.4	0.8	1.2	1.6	2.0	2.4	2.8	3.2	3.6	4.0	4.4	4.8	5.2	5.6	6.0	6.4	6.8	7.2	16
14	27	0.4	0.8	1.2	1.6	2.1	2.5	2.9	3.3	3.7	4.1	4.5	4.9	5.3	5.8	6.2	6.6	7.0	7.4	15
13	28	0.4	0.8	1.3	1.7	2.1	2.5	2.9	3.4	3.8	4.2	4.6	5.0	5.5	5.9	6.3	6.7	7.1	7.6	14
11	30	0.4	0.9	1.3	1.7	2.2	2.6	3.1	3.5	3.9	4.4	4.8	5.2	5.7	6.1	6.6	7.0	7.4	7.9	12
9	1	0.4	0.9	1.4	1.8	2.3	2.7	3.2	3.6	4.1	4.5	5.0	5.4	5.9	6.4	6.8	7.3	7.7	8.2	10
7	3	0.5	0.9	1.4	1.9	2.3	2.8	3.3	3.8	4.2	4.7	5.2	5.6	6.1	6.6	7.0	7.5	8.0	8.5	8
5	5	0.5	1.0	1.4	1.9	2.4	2.9	3.4	3.9	4.3	4.8	5.3	5.8	6.3	6.8	7.3	7.7	8.2	8.7	6
3	7	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	4
1	9	0.5	1.0	1.5	2.0	2.5	3.1	3.6	4.1	4.6	5.1	5.6	6.1	6.7	7.2	7.7	8.2	8.7	9.2	2
30	11	0.5	1.0	1.6	2.1	2.6	3.1	3.7	4.2	4.7	5.3	5.8	6.3	6.8	7.3	7.9	8.4	8.9	9.5	30
28	13	0.5	1.1	1.6	2.1	2.7	3.2	3.8	4.3	4.8	5.4	5.9	6.5	7.0	7.5	8.1	8.6	9.1	9.7	28
26	15	0.5	1.1	1.6	2.2	2.7	3.3	3.8	4.4	4.9	5.5	6.0	6.6	7.2	7.7	8.2	8.8	9.3	9.9	26
24	17	0.6	1.1	1.7	2.2	2.8	3.4	3.9	4.5	5.0	5.6	6.2	6.7	7.3	7.9	8.4	9.0	9.6	10.1	24
21	20	0.6	1.1	1.7	2.3	2.9	3.5	4.0	4.6	5.2	5.8	6.3	6.9	7.5	8.1	8.7	9.2	9.8	10.4	21
18	23	0.6	1.2	1.8	2.4	3.0	3.5	4.1	4.7	5.3	5.9	6.5	7.1	7.7	8.3	8.9	9.5	10.0	10.6	18
15	26	0.6	1.2	1.8	2.4	3.0	3.6	4.2	4.8	5.4	6.0	6.6	7.2	7.9	8.5	9.1	9.7	10.3	10.9	15
12	1	0.6	1.2	1.8	2.5	3.1	3.7	4.3	4.9	5.5	6.2	6.8	7.4	8.0	8.6	9.2	9.8	10.5	11.1	12
9	4	0.6	1.2	1.9	2.5	3.1	3.7	4.4	5.0	5.6	6.3	6.9	7.5	8.1	8.8	9.4	10.0	10.6	11.3	9
6	7	0.6	1.3	1.9	2.5	3.2	3.8	4.4	5.1	5.7	6.3	7.0	7.6	8.2	8.9	9.5	10.1	10.8	11.4	6
3	10	0.6	1.3	1.9	2.6	3.2	3.8	4.5	5.1	5.8	6.4	7.0	7.7	8.3	9.0	9.6	10.3	10.9	11.5	3
30	13	0.6	1.3	1.9	2.6	3.2	3.9	4.5	5.2	5.8	6.5	7.1	7.7	8.4	9.0	9.7	10.3	11.0	11.6	31
27	16	0.7	1.3	1.9	2.6	3.2	3.9	4.5	5.2	5.8	6.5	7.1	7.8	8.4	9.1	9.7	10.4	11.0	11.7	28
24	19	0.7	1.3	2.0	2.6	3.2	3.9	4.5	5.2	5.9	6.5	7.2	7.8	8.5	9.1	9.8	10.4	11.1	11.7	25
21	22	0.7	1.3	2.0	2.6	3.3	3.9	4.6	5.2	5.9	6.5	7.2	7.8	8.5	9.1	9.8	10.4	11.1	11.7	22
Add aft. N. / Sub. bef. N.	Sub. aft. N. / Add bef. N.	$0^h\frac{2}{3}$	$1^h\frac{1}{3}$	2^h0	$2^h\frac{2}{3}$	$3^h\frac{1}{3}$	4^h0	$4^h\frac{2}{3}$	$5^h\frac{1}{3}$	6^h0	$6^h\frac{2}{3}$	$7^h\frac{1}{3}$	8^h0	$8^h\frac{2}{3}$	$9^h\frac{1}{3}$	10^h0	$10^h\frac{2}{3}$	$11^h\frac{1}{3}$	12^h0	Add aft. N. / Sub. bef. N.	Sub. aft. N. / Add bef. N.

Time from Noon.

TABLE X. *Change of Sun's Dec.*

Month.	Days.	Complete Years. 4	8	12	16
January.	1	0′—1	0′—3	0′—4	0′—6
	7	0 .2	0 .4	0 .7	0 .9
	13	0 .3	0 .6	0 .9	1 .2
	19	0 .4	0 .7	1 .1	1 .4
	25	0 .4	0 .8	1 .3	1 .7
February.	1	0 .5	1 .0	1 .5	2 .0
	17	0 .5	1 .1	1 .6	2 .2
	13	0 .6	1 .2	1 .7	2 .3
	19	0 .6	1 .2	1 .9	2 .5
	25	0 .7	1 .3	2 .0	2 .6
March.	1	0 .7	1 .3	2 .0	2 .7
	7	0 .7	1 .4	2 .1	2 .7
	13	0 .7	1 .4	2 .1	2 .8
	19	0 .7	1 .4	2 .1	2 .8
	25	0+.7	1+ 4	2+ 1	2+ 8
April.	1	0 .7	1 .4	2 .1	2 .8
	7	0 .7	1 .4	2 .1	2 .7
	13	0 .7	1 .3	2 .0	2 .6
	19	0 .6	1 .3	1 .9	2 .5
	25	0 .6	1 .2	1 .8	2 .4
May.	1	0 .6	1 .1	1 .7	2 .3
	7	0 .5	1 .0	1 .6	2 .1
	13	0 .5	0 .9	1 .4	1 .9
	19	0 .4	0 .8	1 .2	1 .6
	25	0 .3	0 .7	1 .0	1 .3
June.	1	0 .3	0 .5	0 .8	1 .0
	7	0 .2	0 .4	0 .5	0 .7
	13	0 .1	0 .2	0 .3	0 .4
	19	0 .0	0 .0	0 .1	0 .1
	25	0— 1	0— 1	0— 2	0— 3
July.	1	0 .1	0 .3	0 .4	0 .6
	7	0 .2	0 .4	0 .7	0 .9
	13	0 .3	0 .6	0 .9	1 .2
	19	0 .4	0 .7	1 .1	1 .4
	25	0 .4	0 .9	1 .3	1 .7
August.	1	0 .5	1. 0	1 .5	2 .0
	7	0 .5	1. 1	1 .6	2 .2
	13	0 .6	1. 2	1 .8	2 .4
	19	0 .6	1. 3	1 .9	2 .5
	25	0 .7	1. 3	2 .0	2 .6
September.	1	0 .7	1 .4	2 .0	2 .7
	7	0 .7	1 .4	2 .1	2 .8
	13	0 .7	1 .4	2 .1	2 .8
	19	0 .7	1 .4	2 .1	2 .9
	25	0+ 7	1+ 4	2+ 1	2+ 8
October.	1	0 .7	1 .4	2 .1	2 .8
	7	0 .7	1 .4	2 .0	2 .7
	13	0 .7	1 .3	2 .0	2 .6
	19	0 .6	1 .3	1 .9	2 .5
	25	0 .6	1 .2	1 .8	2 .4
November.	1	0 .5	1 .1	1 .6	2 .2
	7	0 .5	1 .0	1 .5	2 .0
	13	0 .4	0 .9	1 .3	1 .8
	19	0 .4	0 .8	1 .2	1 .5
	25	0 .3	0 .7	1 .0	1 .3
December.	1	0 .2	0 .5	0 .7	1 .0
	7	0 .2	0 .4	0 .5	0 .7
	13	0 .1	0 .3	0 .3	0 .4
	19	0 .0	0 .1	0 .1	0 .3
	25	0 .1	0— 1	0— 1	0— 2

TABLE XI. *The Right Ascensions and Declinations of the Principal fixed Stars, adapted to the beginning of the Year* 1810.

Names of Stars.	Mag.	Right Ascen. in Time.	Ann. Var.	Declination.	Ann. Var.
γ Pegasi	2	0h 3′ 57″	3″.06	14° 7′ 35″ N	+20″.0
β Ceti	2	0 34 2	3 .01	19 3 36 S	—19 .8
Alrucabah, pole star	2.3	0 54 15	12 .42	88 17 41 N	+19 .6
Mirach	2	0 59 7	3 .31	34 36 45 N	+19 .4
Achernar	1	1 30 38	2 .25	58 11 19 S	—18 .5
Almaach	2	1 52 16	3 .62	41 24 47 N	+17 .7
Menkar	2	1 52 20	3 .11	3 20 27 N	+14 .7
Algol	Var.	2 56 0	3 .85	40 12 53 N	+14 .5
Algenib	1	3 10 49	4 .21	49 9 31 N	+13 .6
Aldebaran	2	4 25 1	3 .42	16 9 6 N	+ 8 .2
Capella	1	5 2 40	4 .41	45 47 41 N	+ 5 .1
Rigel	1	5 5 19	2 .87	8 25 48 S	— 4 .8
β Tauri	2	5 14 17	3 .78	28 26 10 N	+ 4 .1
Bellatrix	2	5 14 57	3 .21	6 10 1 N	+ 4 .0
δ Orionis	2	5 22 20	3 .07	0 26 53 S	— 3 .4
ε Orionis	2	5 26 35	3 .04	1 19 57 S	— 3 .0
ζ Orionis	2	5 31 11	3 .03	2 3 8 S	— 2 .6
α Columbæ	2	5 32 45	2 .17	34 10 54 S	— 2 .4
Betelguese	1	5 44 53	3 .24	7 21 40 N	+ 1 .4
β Canis Majoris	2.3	6 14 22	2 .65	17 52 16 S	+ 1 .2
Canopus	1	6 19 43	1 .33	51 35 44 S	+ 1 .7
Sirius	1	6 36 46	2 .65	15 27 48 S	+ 4 .3
δ Canis Majoris	2	7 0 40	2 .44	26 6 0 S	+ 5 .2
Castor	1.2	7 22 27	3 .85	32 17 33 N	— 6 .9
Procyon	1.2	7 29 20	3 .14	5 42 56 N	— 7 .5
Pollux	2.3	7 32 48	3 .69	28 27 28 N	— 7 .9
ζ Navis	2	7 56 44	2 .11	39 28 20 S	+ 9 .7
γ Navis	2	8 3 41	1 .85	46 46 39 S	+10 .3
Acubens	3	8 48 4	3 .30	12 35 19 N	—13. 4
β Navis	1	9 11 6	0 .75	68 56 13 S	+14 .8
Alphard	2	9 18 14	2 .93	7 50 25 S	+15 .2
Regulus	1	9 58 14	3 .20	12 53 29 N	—17 .2
η Navis	2	10 37 43	2 .30	58 41 20 S	+18 .7
β Ursæ Majoris	2	10 50 17	3 .71	57 23 53 N	—19 .1
Dubhe	2	10 51 54	3 .85	62 46 43 N	—19 .1
β Leonis	2	11 39 21	3 .06	15 37 9 N	—19 .9
γ Ursæ Majoris	2	11 47 45	3 .22	54 44 7 N	—20 .0
α Crucis	1	12 16 9	3 .24	62 2 46 S	+20 .0
γ Crucis	2	12 20 42	3 .24	52 2 42 S	+20 .0
β Crucis	2	12 36 44	3 .41	58 38 55 S	+19 .8
Aliath	2	12 45 36	2 .67	57 10 48 N	—19 .7
Spica Virginis	1	13 15 11	3 .13	10 9 54 S	+19 .0
ζ Ursæ Majoris	2	13 16 23	2 .43	55 54 8 N	—19 .0
Benetnach	2	13 40 4	2 .40	50 15 58 N	—18 .2
β Centauri	1.2	13 50 32	4 .11	59 26 51 S	+17 .8
Arcturus	1	14 6 59	2 .72	20 10 34 N	—19 .1
α Centauri	1	14 27 16	4 .45	60 3 17 S	+16 .1
Alphacca	2	15 26 38	2 .53	27 21 44 N	—12 .5
β Scorpii	2	15 54 26	3 .47	10 16 29 S	+10 .5
Antares	1	16 17 45	3 .64	25 59 49 S	+ 8 .7
Ras. Algethi	2	17 5 59	2 .73	14 36 57 N	— 4 .8
Ras. Alhague	2	17 26 7	2 .77	12 42 37 N	— 3 .0
Vega	1	18 30 30	2 .02	38 36 35 N	+ 2 .6
Altair	1.2	19 41 30	2 .92	8 22 13 N	+ 8 .5
Deneb	2	20 34 56	2 .03	44 36 13 N	+12 .5
Gruis	2	21 56 11	3 .85	48 1 58 S	—17 .1
Fomalhaut	1	22 47 6	3 .33	30 48 14 S	—19 .0
Scheat	2	22 54 34	2 .87	27 3 7 N	+19 .2
Markab	2	22 55 17	2 .96	27 3 7 N	+19 .2
α Andromedæ	2	23 58 34	3 .07	28 2 31 N	+20 .0

Navigation, Inland Navigation.

Navigation of the Ancients. See Phoenicia and Trade.

Inland Navigation, the method of conveying commodities from one part of a country to another by means of rivers, lakes, canals, or arms of the sea. See Canal.

We have already, under Canal, taken notice of a method proposed by Dr Anderson of raising and lowering vessels by means of mechanical powers, instead of dams and locks. We shall describe another mechanical contrivance proposed by Mr Leach for the same purpose. This machinery is compounded of an inclined plane and wheel in axis. The inclined plane is a parallelogram whose length reaches from the end of one canal to the beginning of another, or to the sea or navigable river, to which the vessel is next to be conveyed; the breadth ought to be $22\frac{1}{2}$ feet, It may be made of good oak or deal plank, and sufficiently strong to bear the weight to be laid upon it; and it must be very strongly supported by beams of oak or other wood. It ought to be divided in the middle by a ledge or rib of 12 inches square, the side ribs being nine by 12 inches. The elevation must depend upon particular circumstances. Fig. 1. shows the inclined part of the machine; AB being the wooden part just described, placed between the side of the hill W and the navigable river F. According to the dimensions already given, the two paths A and B on which the vessels move are exactly ten feet wide. G represents the canal, brought perhaps from the distance of several miles to the top of the precipice WW. At the end of the canal, and quite across from R to R, must be built a very strong wall; in which are two sluices with flood gates at K and L, to let out the water occasionally. Between the head of the plane AB, and the end of the canal G, is a horizontal platform divided into two parts, as is represented in the figure by the letters HI. At the end of the canal are six rollers M and N, of use in carrying the boats and lighters in and out of the canal. Near the end of the canal, at S, and T, are two other sluices, with their flood-gates, for letting out a quantity of fluid to drive the other part of the machine. O and P represent the two ends of the towing paths, one on each side of the canal.

Plate CCCLXIX. fig. 1.

Fig. 2. shows the vehicle by which the lighters are conveyed up and down the inclined plane, by the two paths A and B, fig. 1. AA (fig. 2.) represents part of the inclined plane, B the vehicle in the position in which it rolls up and down the two paths. C is the body of the vehicle, which is made hollow, to contain a quantity of water occasionally used as a counterbalance for its corresponding vehicle. DDD are three rollers between the bottom of the vehicle and the plane, for the purpose of rolling the boats up and down. HHH are six rollers; four by the horizontal part of the vehicle on which the boat E is to rest in its passage up and down the plane; the other two rollers are in a moveable part, which is fastened to the body of the vehicle with a pair of very strong hinges: and in the passage of the vehicle up and down the plane, it turns up between the head of the boat and the plane, preventing the former from rubbing against the plane. When the vehicle gets up to the top, this moveable part falls down on the platform marked HI, becoming parallel with the horizontal part of the vehicle; after which it serves for a launch and passage to place the boat upon the rollers MN (fig. 1.) at the end of the canal. This passage part of the vehicle, together with the three rollers at the end of the canal, is likewise of great use in towing a boat out of the canal, in order to place it on the horizontal part. At the bottom of the cavity of the vehicle is a large hole F, with a valve opening inwardly. Through this hole the water enters when the vehicle sinks into the navigable river F, for the purpose of receiving a boat on the top or horizontal part of the vehicle, till it is quite full, and then will sink entirely under water, while the boat is towed in on the horizontal part. A small rope K is fastened to the valve, on purpose to lift it up and to keep it so, while the vehicle and boat are ascending up the plane out of the canal; that so the water may discharge itself till as much as is necessary be got out, or till it becomes an equal balance for the corresponding vehicle and its contents, which are descending by the other path. Hence we see, that every machine must have two of these vehicles furnished with rollers as already described, and so constructed that one may be as nearly as possible a counterbalance to the other. As it is necessary that the vehicles should be water tight, the insides of them must be caulked very tight; and they should be capacious enough to hold as much water as will balance the largest boat with its contents. Here it may be observed, that every vessel will be balanced by as many cubic feet of water as it displaces by being put into the water when loaded. The quantity may easily be known, by observing how far the boat sinks in the water, and calculating the bulk of the part immersed.

Fig. 2.

Inland Navigation.

The machine which puts the vehicles in motion, may either be constructed with an under-shot or breast-water wheel: or by an over-shot water-wheel: or by two walking-wheels, for men to walk in as in cranes, &c.

Fig. 3. shows a front view of the under-shot water-wheel movement; where A is the end of the axis or cylinder of the cog or spur wheel; the diameter of which axis is four feet, and its length not less than 22 feet, as it must be extended quite across the canal from one side to the other, and placed on the top of very strong supporters on each side of the canal, about seven feet above the surface of the water, as the loaded boat is to pass backwards and forwards under the cylinder, and at a convenient distance from the wall RR (fig. 1.); and placed between the two sluices S and T; on the end of which cylinder is the cog-wheel B (fig. 3.). The wheel B is supposed to be 20 feet of diameter, having on its edge 120 cogs, and underneath the cog-wheel is the breast-water one C, 24 feet in diameter, from the tip of one aller-board to the tip of its opposite. On the end of the axis of the water-wheel D is a trundle two feet and a half in diameter, with 15 rounds and staves contained therein. This must be placed between the two sluices S and T, to let the water out of the canal; which, falling on the float-boards, will turn the wheel round from the right hand towards the left, when the sluice on the left hand of the wheel is opened; but the contrary way when that of the right is opened.—The water

Fig. 3.

falling

Inland Navigation.

falling upon the boards passes along with the wheel in the circular cavity EGF, and is discharged at G, whatever way the wheel may turn.

To the axis or cylinder of this machine, which must always be horizontal, are fixed a pair of strong ropes; the ends of each pair fastened to the upper part of the cylinder; it being necessary that they should act in contrary directions. Each must extend the whole length of the plane, and their strength must be proportioned to the weight necessary to be sustained. The two vehicles already mentioned are fastened to the other ends of the ropes; so that one pair of the ropes are wound up by the cylinder turning one way, and the other by its turning the contrary way. Thus when Fig. 1. one of the vehicles is at the upper part of the path A, ready to discharge its boat and cargo into the upper canal, the other boat will be at the foot of the path B, all under water in the lower canal, and ready for the reception of a boat to be towed in on the horizontal part of it; so that as one vehicle rolls up on one side of the plane, the other will roll down on the other side, and *vice versa*.

Fig. 4. Fig. 4. shows the movement by means of an over-shot water-wheel. It consists of a water-wheel C, and two spur or cog-wheels A and B. The water-wheel is 18 feet in diameter, and has two rows of buckets placed contrariwise to one another, that it may turn round in contrary directions, according as the one or the other sluice, S, or T, is opened. On its axis F is a trundle of three feet diameter, having 18 rounds or staves which fall into the cogs of the second spur-wheel B, causing it to turn round in a direction contrary to that of the water-wheel. This second wheel is likewise 18 feet in diameter, with a trundle of three feet having 18 rounds or staves.—The diameter of the upper spur-wheel A is also 18 feet, but the diameter of its axis is six feet. On the edge of the wheel are 108 cogs. These fall in between the staves of the axis of the other spur-wheel; and thus the third wheel turns round the same way with the water wheel C. The cylinder of this upper spur-wheel must be placed across the canal betwixt the two sluices, on very strong supporters, as explained in the former movement, and the two pair of ropes in the same manner.

Fig. 5. The movement of the walking wheel is shown (fig. 5.). A1 and A2 are two wheels for men to walk in, each of them 24 feet in diameter. B1 and B2 are the axes or cylinders of the two wheels, of equal lengths; viz. 11 feet each, and four in diameter.—At one end of each of the two cylinders C1 and C2, is a wheel of the same diameter with the cylinder. On the edges of these wheels are teeth of an equal number in each wheel; and as the teeth of the wheels mutually fall into each other, the revolutions of both must be performed in the same time. By this contrivance also the cylinders will turn different ways; and the ropes on the two different cylinders will constantly one pair be wound up, and the other wound down, by the natural moving of the machine. DDD is the frame that supports the whole, which must be made very firm and secure.

Let us now suppose, that there is a boat in the upper canal to be brought down, but none to go up for a balance. In this case, as one of the vehicles must be at the top to receive the boat, the other will be at the bottom to take in water. Let then any of the movements just described be set to work, and it is plain, that as the upper vehicle with its boat descends, the under vehicle will ascend with the water; the valve being in the mean time lifted up till a sufficient quantity of water has flowed out, to make the one nearly a counterbalance to the other; so that the vessel may slide down gently and without any violence.

Inland Navigation || Naumachia.

If it happens that a boat is to go up while none is to come down, one of the vehicles being at the foot of the plane under water, and in readiness to have the boat towed upon its horizontal part, one of the sluices at K or L is to be opened, and a quantity of water let into the cistern of the upper vehicle sufficient to counterbalance the boat with the contents which is to ascend. This being done, the machine is set to work, the valve of the under vehicle kept open till the water is all discharged; and then the boat will roll up to the top of the plane.

From this description of the canal and machinery for raising and lowering the vessels, the reader can be at no loss to understand the principles on which it depends. It would be superfluous to adduce examples, or follow our author through his calculations relative to particular cases. We shall only observe, that the difference of time in which vessels may be raised or lowered by the machinery just described, in comparison with what can be done in the common way by dams and locks, must give a very favourable idea of the new method. According to Mr Leach's computations, a boat with its cargo weighing 10 tons might be raised by the walking machine in 12 or 14 minutes, by the under-shot wheel in 15 minutes, and by the over-shot wheel in 30 minutes; and that through a space of no less than 30 fathoms measured on the inclined plane, or 114 feet perpendicular.

NAVIGATORS ISLANDS. See OPOUN.

NAULUM, in Roman antiquity, a piece of money put into the mouth of a person deceased, to enable him to pay Charon the ferryman for his passage. It was to be of the current coin of the reigning emperor; so that from this money the time of the person's death may be known. The sum for poor men was a farthing, but the rich in general were very liberal to Charon, as appears from the number of coins often found in the neighbourhood of Rome on opening the graves of great men. Charon was looked upon as a very morose and obstinate old fellow, who would not carry over any man without his fare: and hence the proverbial use of that verse in Juvenal,

Furor est post omnia perdere naulam.

A similar custom took place among the Greeks: The money put into the mouth of the deceased was by them called Δανακη.

NAUMACHIA, in antiquity, a show or spectacle among the ancient Romans, representing a sea fight. These mock sea fights are supposed to have originated at the time of the first Punic war, when the Romans first instructed their men in the knowledge of naval affairs. Afterwards they were intended to entertain the populace, as well as to improve the seamen. They were often, like other shows, exhibited at the expence of individuals, to increase their popularity.

In

INLAND NAVIGATION. PLATE CCCLXIX.

Fig. 1.

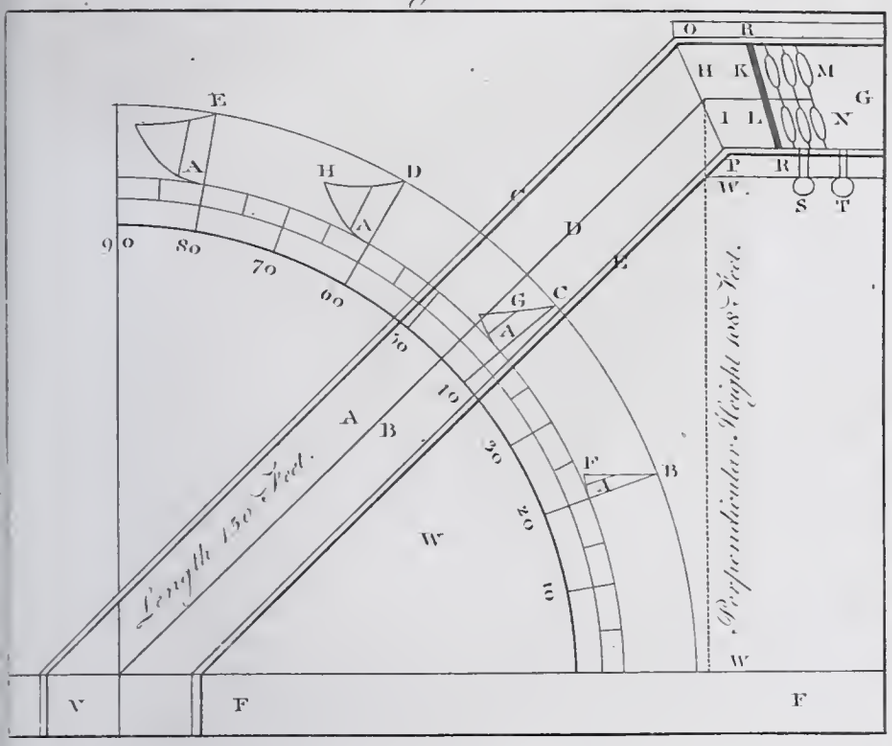


Fig. 2.

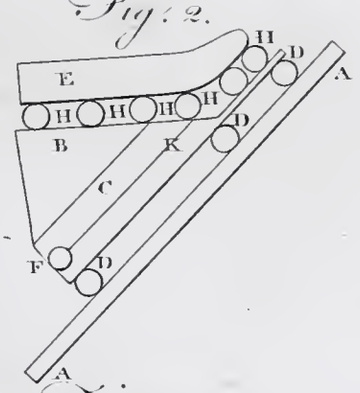


Fig. 3.

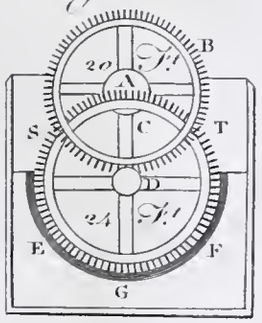


Fig. 4.

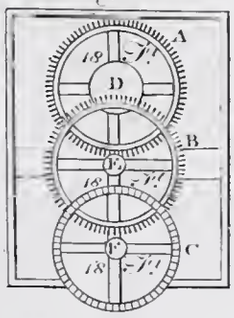
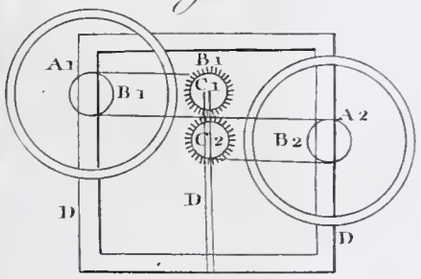


Fig. 5.



NAPIERS RODS.

Fig. 1.

1	1	2	3	4	5	6	7	8	9	0
2	2	4	6	8	1 0	1 2	1 4	1 6	1 8	0
3	3	6	9	1 2	1 5	1 8	2 1	2 4	2 7	0
4	4	8	1 2	1 6	2 0	2 4	2 8	3 2	3 6	0
5	5	1 0	1 5	2 0	2 5	3 0	3 5	4 0	4 5	0
6	6	1 2	1 8	2 4	3 0	3 6	4 2	4 8	5 4	0
7	7	1 4	2 1	2 8	3 5	4 2	4 9	5 6	6 3	0
8	8	1 6	2 4	3 2	4 0	4 8	5 6	6 4	7 2	0
9	9	1 8	2 7	3 6	4 5	5 4	6 3	7 2	8 1	0

Fig. 2.

1	4	7	6	8
2	8	1 4	1 2	1 6
3	1 2	2 1	1 8	2 4
4	1 6	2 8	2 4	3 2
5	2 0	3 5	3 0	4 0
6	2 4	4 2	3 6	4 8
7	2 8	4 9	4 2	5 6
8	3 2	5 6	4 8	6 4
9	3 6	6 3	5 4	7 2

DIPPING NEEDLE.

Fig. 1.

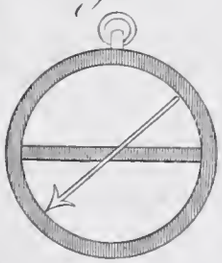
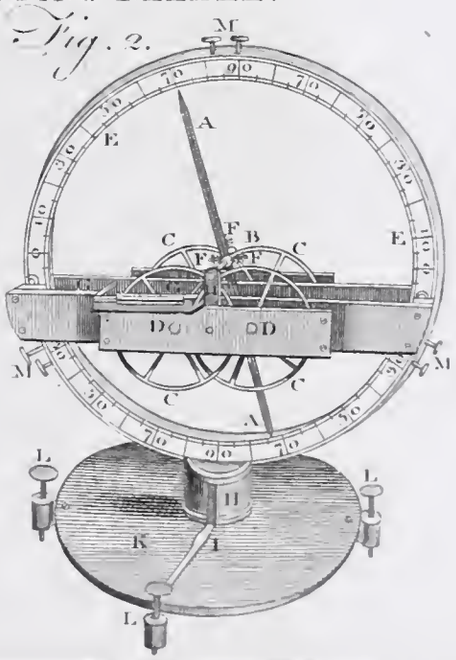
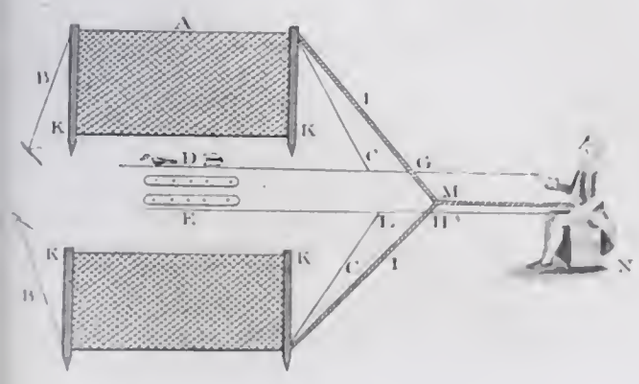


Fig. 2.



DAY NET.



NEWTONIAN PHILOSOPHY.

Fig. 1.

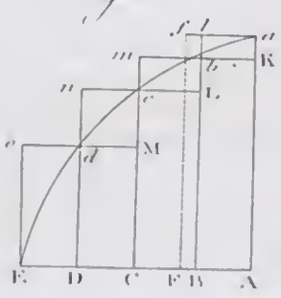
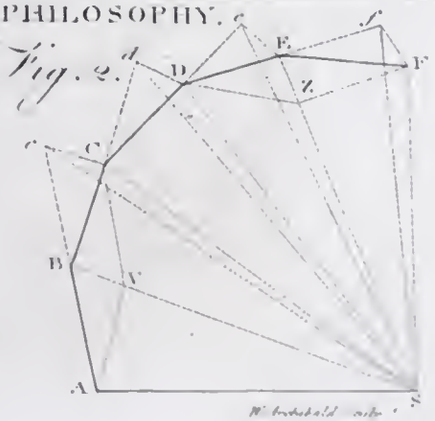


Fig. 2.



Naumachia || Nauplius.

In these spectacles they sometimes strove to excel each other in swiftness; and sometimes engaged in a warlike manner. The naumachiæ of Cladius indeed was a most savage diversion. The combatants used to destroy each other to amuse a tyrant and a cruel mob. As they passed before him, they used this melancholy greeting, "*Ave Imperator, morituri te salutant.*" The emperor replied, "*Avete vos.*" This they understood as an answer of kindness, and a grant of their lives; but they soon discovered that it proceeded from wanton cruelty, and barbarous insensibility. In the time of the emperor Domitian, such a vast number of vessels engaged as would have nearly formed two regular fleets for a real fight, and the channel of water was equal in magnitude to a natural river. The emperor Heliogabalus is reported to have filled the channel where the vessels were to ride with wine instead of water. Tritons and sea monsters were frequently exhibited during the engagement. Suetonius and Dio Cassius inform us, that at one of these sea fights of Domitian a violent shower fell; the emperor, however, continued till the end of the engagement, often changing his clothes, nor would he suffer any one to depart; and as the rain continued for several hours, many were seized with distempers, and some even died, Suet. cap. 4. Dio. lib. lxvii. Naumachiæ were also places fitted up for these shows, a sort of circi or amphitheatres, with seats and porticoes, &c. There were several of them at Rome; three built by Augustus, one by Claudius, another by Domitian, and another by Nero: which served for the reverse of his medals. Claudius used the lake Fucinus as a naumachia.

NAUMBURG, a town of Germany, in the circle of Upper Saxony, capital of the county of Saxe-Naumburg, situated on the siver Sala, in E. Long. 11. 20. N. Lat. 51. 12.

NAUPACTUS, or NAUPACTUM, in *Ancient Geography*, a city of Ætolia, at the mouth of the Evenus. The word is derived from ναυς and πηγνυμι, because it was there that the Heraclidæ built the first ship which carried them to Peloponnesus. It first belonged to the Locri Ozolæ, and afterwards fell into the hands of the Athenians, who gave it to the Messenians, who had been driven from Peloponnesus by the Lacedæmonians. It became the property of the Lacedæmonians after the battle of Ægospotomos, and it was restored to the Locri. Philip of Macedon afterwards took it, and gave it to the Ætolians; from which circumstance it has generally been called one of the chief cities of their country. E. Long. 22. 20. N. Lat. 38. 0.

There was on the shore a temple of Neptune, and near it a cave filled with offerings, and dedicated to Venus, where widows resorted to request new husbands of the goddess. Pausan. lib. x. p. 898.

NAUPLIA, in *Ancient Geography*, a maritime city of Peloponnesus. It was the naval station of the Argives. The fountain Canathos was in its neighbourhood.

NAUPLIUS, in fabulous history, a son of Neptune and Amymone, king of Eubœa. He was the father of the famous Palamedes, who was so unjustly sacrificed to the artifice and resentment of Ulysses by the Greeks at the Trojan war. The death of Palamedes highly enraged Nauplius; and to revenge the injustice of the Grecian princes, he endeavoured to debauch their wives, and ruin their characters. When the Greeks returned from the Trojan war, Nauplius was pleased to see them distressed in a storm on the coasts of Eubœa; and to make their disaster still more universal, he lighted fires on such places as were surrounded with the most dangerous rocks, that the fleet might be shipwrecked upon the coast. This had the desired effect; but Nauplius was so disappointed when he saw Ulysses and Diomedes escape from the general distress, that he threw himself into the sea. According to some mythologists there were two persons of this name: one a native of Argos, who went to Colchis with Jason. He was son of Neptune and Amymone.—The other was king of Eubœa, and lived about the time of the Trojan war. He was, as some observe, son of Clytonas, one of the descendants of Nauplius the Argonaut. The Argonaut was remarkable for his knowledge of sea affairs and of astronomy. He built the town of Nauplia, and sold Auge daughter of Aleus to King Teuthras, to screen her from her father's resentment.

Nauplius || Nauscopy.

NAUPORTUS, or NAUPORTUM, in *Ancient Geography*, a town on a cognominal river, towards its source, in Pannonia Superior. The reason of the name, according to Pliny, is that the ship Argo, after coming up the Danube, the Save, and the Laubach, was thence carried on men's shoulders over the Alps into the Adriatic. The river Nauportus rises in the Alps, near Longaticum, at the distance of six miles from the town Nauportum; which was a colony of the Taurisci, a people on the confines of Noricum. Now *Upper Laubach* in Carinthia, on the river Laubach. E. Long. 14. 40. N. Lat. 46. 28.

NAUSCOPY, the art of discovering the approach of ships or the neighbourhood of land at a considerable distance. This pretended art was discovered by M. Bottineau, employed in the king and company's service in the island of France, from the year 1782 to 1784; the account of it is as follows:

"This knowledge is not derived either from the undulation of the waves, or from the subtility of sight, or from any particular sensation; but merely from observation of the *horizon*, which discovers signs indicating the proximity of ships or of land.

"On the *approximation* of a ship toward the land, or towards another ship, there appears in the atmosphere a *meteor* of a particular nature, visible to every one without any *painful attention*. It is not by any kind of accident that this meteor appears under these circumstances; on the contrary, it is the necessary result of the approximation of one vessel towards another, or towards the land. The existence of the *meteor*, and the knowledge of its different modifications, are what constitute the certainty and the precision of my information.

"If I am asked, how it is possible that the approach of a ship towards land should give birth to any *meteor* whatsoever in the atmosphere, and what connexion there can be between two objects at such a distance from each other? I reply, that I am not obliged to give an account of the *hows* and the *wherefores*: that it is sufficient for me to have discovered the fact, without being obliged to account for its principle."

The writer concludes, by desiring to be called on for experimental proofs, and by promising in future a complete treatise of Nauscopy, with maps, plates, &c.

This

Nauscopy, Naworth Castle.

This complete treatise, as far as we know, has not yet been published; nor do we expect ever to see such a treatise on the subject as will satisfy the minds of those who are persuaded that every effect must have an adequate cause. The whole seems to be the work of fancy.

NAUSEA, or SICKNESS; a retching or propensity and endeavour to vomit, arising from something which irritates the stomach.

NAUTILUS, a genus of animals belonging to the order of vermes testacea. See CONCHOLOGY *Index*.

NAVY, the fleet or shipping of a prince or state. See MARINE,

The management of the British royal navy, under the lord high admiral of Great Britain, is intrusted to principal officers and commissioners of the navy, who hold their places by patent. The principal officers of the navy are four, viz. the treasurer, whose business it is to receive money out of the exchequer, and to pay all the charges of the navy, by warrant from the principal officers: comptroller, who attends and controuls all payment of wages, is to know the rates of stores, to examine and audit all accounts, &c.: surveyor, who is to know the states of all stores, and see wants supplied; to estimate repairs, charge boatswains, &c. with what stores they receive, and at the end of each voyage to state and audit accounts: clerk of the acts, whose business it is to record all orders, contracts, bills, warrants, &c.

The commissioners of the navy are five: The first executes that part of the comptroller's duty which relates to the comptrolling the victualler's accounts; the second, another part of the said comptroller's duty relating to the account of the storekeepers of the yard; the third has the direction of the navy at the port of Portsmouth; the fourth has the same at Chatham; and the fifth at Plymouth. There are also other commissioners at large, the number more or less according to the exigencies of public affairs; and since the increase of the royal navy, these have several clerks under them, with salaries allowed by the king.

The victualling of the royal navy hath formerly been undertaken by contract; but is now managed by commissioners, who hold their office on Tower-hill, London. The navy office is where the whole business concerning the navy is managed by the principal officers and commissioners.

The royal navy of Great Britain is now in a very flourishing state, having been diligently kept up in late reigns, as the natural strength of the kingdom. When it is complete, it is divided into three squadrons, distinguished by the colours of the flags carried by the respective admirals belonging to the same, viz. *red*, *white*, and *blue;* the principal commander of which bears the title of *admiral;* and each has under him a vice admiral and a rear admiral, who are likewise flag officers.

NAVY Exercise. See EXERCISE.

NAVY Discipline, or *Regulations.* See *MARITIME State.*

NAWORTH CASTLE, in Cumberland, 10 miles from Carlisle, near the Gelt. This castle is still entire and inhabited. It is a large pile, square, and built round a court. On the north it stands over the river Ithing, at a great height, the banks shagged with wood. The whole house is a very irregular building; the rooms numerous, accessible by 16 staircases, with most frequent and sudden ascents and descents, &c.— The great hall has a gallery at one end, adorned with four vast crests carved in wood, viz. a griffin and dolphin, with the scallops; an unicorn, and an ox with a coronet round his neck. In front is a figure in wood of an armed man; two others, perhaps vassals, in short jackets and caps. The top and upper end of the room is painted in squares, representing the Saxon kings and heroes. This castle was built by one of the Dacres about the reign of Henry III. In the garden walls were stones with Roman inscriptions, which the late earl of Carlisle gave to Sir Thomas Robinson, and were by him removed to his museum at Rooksby: On one of these stones is this inscription, *peditum centum quinquaginta Britannorum;* whence it appears that the Romans, when in possession of Britain, sometimes indulged the national troops with the favour of garrisoning their own territories.

Naworth Castle || Naxus.

NAXIA, or NAXOS, a considerable island of the Archipelago, 25 miles in length, and 88 in circumference. The whole island is covered with orange, olive, lemon, cedar, citron, pomegranate, fig, and mulberry trees; and there are a great many springs and brooks. This island has no harbour; and yet they carry on a considerable trade in barley, wine, figs, cotton, silk, flax, cheese, salt, oxen, sheep, mules, and oil. They burn only oil of mastich, though olive oil is exceedingly cheap. It is inhabited both by Greeks and Latins, who live in great dread of the Turks; for when the meanest of their ships appear here, they always wear red caps like galley-slaves, and tremble before the lowest officer; but as soon as they are gone, they put on their caps of velvet. The ladies are so vain, that when they return out of the country they have 40 women in their train, half on foot and half on asses, one of whom carries a napkin or two, another a petticoat, another a pair of stockings, and so on; which is a very ridiculous sight to strangers. There are four archbishops sees in this island, and a great many villages; but so thin of people, that the whole island does not contain above 8000 inhabitants. The highest mountain is *Zia*, which signifies "the mountain of Jupiter." There are but few antiquities, except some small remains of the temple of Bacchus. Some say they have mines of gold and silver; however, there is one of emery, which is so common here and so cheap, that the English often ballast their ships therewith.

NAXOS, or NAXIA, a considerable town, and capital of the isle of Naxos, over against the isle of Paros, with a castle and two archbishops sees, the one Greek and the other Latin. The greatest part of the inhabitants are Greeks. E. Long. 25. 51. N. Lat. 37. 8.

NAXUS, now NAXIA, formerly *Strongyle*, *Dia*, *Dionysias*, *Callipolis*, and *Little Sicily*. It was called *Strongyle*, from a Greek word, signifying "round," though in reality it is rather square than round. The names of *Dia* or *Divine*, and *Dionysias*, were given it as being consecrated in a peculiar manner to the fabulous god Dionysus or Bacchus. The appellation of *Callipolis*, Pliny and Solinus derive from the metropolis of the island, formerly a most beautiful city, which

Naxus. which is the import of the word Callipolis. The great fertility of the country gave rise to the name of *Little Sicily*, Naxus being the most fruitful of all the Cyclades, as Agathamerus informs us, and no less fertile than Sicily itself. As for the name of *Naxus*, some assert that it was borrowed from one Naxus, under whose conduct the Carians possessed themselves of the island; others pretend it received its name from Naxus, the son of Endymion. Stephanus, Suidas, and Phavorinus, derive the name of *Naxos*, from the Greek word *naxai*, signifying, "to sacrifice," and will have it to have been so called from the many sacrifices offered here to Bacchus. With these Bochart agrees, as to its being called *Naxos* from the sacrifices performed here in honour of Bacchus, but will have the word *naxos* to be a corruption of the Phœnician *nasca*, or *nicsa*, signifying "a sacrifice, offering." Naxos is, according to Pliny, 75, but reckoned by the present inhabitants 100 miles, in compass. It has Paros to the west, Myconos and Delos to the north, and Ios to the south. This island is the most fruitful of the Archipelago, and was formerly famed for the excellent wines it produced. Archilochus, as quoted by Athenæus, compares them to the nectar of the gods; and Asclepiades, cited by Stephanus, assures us, that Bacchus took more delight in Naxos than in any other place whatsoever, having himself taught the inhabitants to cultivate their vines. The wine of Naxos maintains to this day its ancient reputation, being by some deemed the best of the Levant. Besides wine, this island abounds with all sorts of delicious fruits, the plains being covered with orange, olive, lemon, cedar, citron, pomegranate, mulberry, and fig trees. It was formerly famous for quarries of that sort of marble which the Greeks called *ophites*, from its being green, and speckled with white spots like the skin of a serpent. The best emerald is found here on the mountains near the western coast, whence the neighbouring cape is called by the Italians *capo smeriglio*, or the emerald cape. As to the inhabitants of Naxos, Diodorus relates that the island was first peopled by the Thracians. These were in a little time subdued by a body of Thessalians, who, having possessed the island for the space of 200 years and upwards, were compelled to abandon it by a drought and famine.

After the Trojan war, the Carians settled here, and called the island *Naxos*, from their king, who was the son of Polemon. He was succeeded by his son Leucippus, and Leucippus by his son Smardius, in whose reign Theseus, coming out of Crete, landed here with Ariadne, whom he was, in his sleep, commanded by Bacchus to leave in this island. In process of time a colony of Cnidians and Rhodians settled here under the conduct of Hippothous and Xuthus: and last of all the Ionians, who, in time, possessed the whole island; whence the Naxians are, by Herodotus, called *Ionians*, and ranged among the Athenian colonies. E. Long. 26. 5. N. Lat. 36. 30. It is about 105 miles in circumference, and about 30 broad.

Naxus, in *Ancient Geography*, a town of Crete, famous for its hones, called *lapis Naxius*. Another of Sicily, built by the Chalcidians; situated on the south side of Mount Taurus, destroyed by Dionysius the tyrant: from its ruins Tauromenium, built by Timoleon, either arose or was increased, (Plutarch). Naxus ‖ Nazareth.

NAYRES, the nobility of the Malabar coast. We may with truth affirm that they are the oldest nobility in the world; for the most ancient writers mention them, and quote the law that permits the Nayre ladies to have many husbands; every one being allowed four. Their houses, which stand single, have as many doors as the lady has husbands. When one of them visits her, he walks round the house, striking with his sabre on his buckler; he then opens his door, and leaves a domestic with his arms in a kind of porch, who serves to inform others that the lady is engaged. It is said, that one day in the week the four doors are all opened, and all her husbands visit her, and dine together with her. Each husband gives a sum of money, or portion, at the time of marriage; and the wife only has the charge of the children. The Nayres, even the Samorin, and the other princes, have no other heirs than the children of their sisters. This law was established, that the Nayres, having no family, might be always ready to march against the enemy. When the nephews are of age to bear arms, they follow their uncles. The name of *father* is unknown to a Nayre child. He speaks of the husbands of his mother and of his uncles, but never of his father.

NAZARETH, a little city in the tribe of Zebulun, in Lower Galilee, to the west of Tabor, and to the east of Ptolemais. Eusebius says, it is 15 miles from Legion towards the east. This city is much celebrated in the Scriptures, for having been the usual place of the residence of Jesus Christ for the first 33 years of his life, Luke ii. 51. It was there our Saviour became incarnate, where he lived in obedience to Joseph and Mary, and from whence he took the name of a Nazarean. After he had begun to execute his mission, he preached there sometimes in the synagogue, *Id.* iv. 16. But because his countrymen had no faith in him, and were offended at the meanness of his original, he did not many miracles there, Matth. xiii. 54, 58. nor would he dwell therein; so he fixed his habitation at Capernaum for the latter part of his life, *Id.* iv. 13. The city of Nazareth was situated upon an eminence; and on one side there was a precipice, from whence the Nazareans one day had a design of throwing down our Saviour, because he upbraided them with their incredulity, Luke iv. 29.

St Epiphanius says, that in his time Nazareth was only a village, and that to the reign of Constantine it was inhabited by Jews alone, exclusive of all Christians. Adamnanus, a writer of the seventh age, says, that in his time there were two great churches to be seen at Nazareth, one in the midst of the city, built upon two arches, in the place where our Saviour's house had stood. Under the two arches now mentioned, was a very fine fountain, which furnished water to the whole city, and from whence water was drawn also by the help of a pulley for the use of the church above. The second church of Nazareth was built in a place where the house stood wherein the angel Gabriel revealed to the virgin Mary the mystery of our Lord's incarnation; and we are assured that the church of the Incarnation, which is supported by two arches, is still in being to

Nazareth, Nazarite.

this day. Mr Maundrell tells us, that there is a convent built over what is said to be the place of annunciation; for the chamber where she received the angel's salutation was about 500 years ago removed from Nazareth, and, according to the Roman legends, transported by angels to Loretto, then a small village in the pope's dominions, now become a bishop's see.—However, Calmet's opinion (which is certainly the true one) upon the different translations of this famous house of Loretto, is, that they were no other than so many different buildings made upon the model of the church of Nazareth, just as in several places sepulchres have been built upon the model of that at Jerusalem. Mariti tells us, that in the eastern part of the city stands the church dedicated to the Blessed Virgin: the zeal of the Cœnobites raised it from the ruins of that which had been destroyed by the Saracens. It is a very handsome building, and consists of three naves; in the middle of which is the principal altar; to which there is an ascent by two magnificent stairs, much admired for their iron ballustrades, the work of an ingenious monk of the convent. The descent to the grotto or annunciation chapel below is by steps of beautiful marble, cut with great taste. Two beautiful columns of oriental granite strike the eye of the observer in the entrance. They appear to have been constructed both to support and ornament the grotto. The altar of this subterranean chapel is extremely elegant; and the different kinds of marble with which it is ornamented, receive an additional lustre from the combined light of several silver lamps presented by Christian princes. On solemn festivals, the walls and the pilasters are ornamented with various pieces of tapestry, representing the mysteries of the virgin; a superb present from the House of Austria. In the western part of the city stands a Christian church, built, as it is said, on the site of the ancient synagogue where Jesus showed the Jews the accomplishment of the prophecies in his person. This place served a long time as a shelter for flocks, but at present it is in good repair. In the neighbourhood may be seen a fountain of excellent water, which is, however, esteemed by the people on another account. They conjecture that it was contiguous to the habitation of the virgin, and that it was used by her. At some distance is a large stone of a round form, called *Christ's Table*. It is pretended that he came hither more than once with his disciples to eat. The inhabitants of Nazareth pay it a kind of worship, burning perfumes and incense around it. It is situated in 35° E. Long. and in 32° N. Lat.; and formerly held the third rank under the patriarch of Jerusalem. At present it is part of the domains of the chief of Acre. The ancient city, after the ravages of fanaticism, was reduced to a miserable hamlet, containing only a few Arab huts.—Under the protection of Daher Omar, however, it recovered very considerably, and is now of far more importance.

NAZARITE, or NAZAREAN, or *Nazarines*, a term which may signify, 1. One that is of Nazareth, or any native of this city. 2. It was given to Jesus Christ and his disciples, and is commonly taken in a sense of derision and contempt in such authors as have written against Christianity. 3. It has been taken for a sect of heretics called Nazarcans. 4. For a Nazarite, a man that has laid himself under the obligation of a vow to observe the rules of Nazariteship, whether it be for his whole life, as Samson and John the Baptist, or only for a time, as those mentioned in Numbers vi. 18, 19, 20. Amos ii. 11, 12. Lastly, The name Nazarite, in some passages of Scripture, denotes a man of particular distinction and great dignity in the court of some prince. But we must speak of these several sorts of Nazarites something more distinctly. Nazarite.

The name of Nazarene belongs to Jesus Christ, not only because of his having lived the greatest part of his life at Nazareth, and because this city has always been considered as his country, but also because the prophets had foretold that he should be called a Nazarene, Matth. ii. 23. "And he came and dwelt in a city "called Nazareth, that it might be fulfilled which was "spoken by the prophets, He shall be called a Naza-"rene." We find no particular place in the prophets in which it is said that the Messiah should be called a Nazarene; and St Matthew only quotes the prophets in general. Perhaps he would insinuate, that the consecration of the Nazarites, and the great purity of which they made profession, was a type and a sort of prophecy of those of our Saviour, or else that the name נזיר *Nazir* or *Nazarite* given to the patriarch Joseph, Gen. xlix. 26. Deut. xxxiii. 16. was a prophecy which was to be fulfilled in the person of Jesus Christ, of whom Joseph was a figure. Lastly, St Jerome was of opinion, that St Matthew here alludes to that passage of Isaiah xi. 1. and lx. 21. "And "there shall come forth a rod out of the stem of Jesse, "and a branch (in Hebrew *Nezer*) shall grow out of "his roots." This branch or *Nezer*, and this rod, are certainly intended to denote Jesus Christ, by the general consent of all the fathers and interpreters.

When the word Nazarean is put for the heretics known by this name, it denotes Christians converted from Judaism, whose chief error consisted in defending the necessity or expediency of the works of the law, and who obstinately adhered to the practice of the Jewish ceremonies. The name of Nazarenes at first had nothing odious in it, and it was often given to the first Christians. The fathers frequently mention the gospel of the Nazarenes, which differs nothing from that of St Matthew, which was either in Hebrew or Syriac, for the use of the first converts, but was afterwards corrupted by the Ebionites. These Nazareans preserved this first gospel in its primitive purity. Some of them were still in being in the time of St Jerome, who does not reproach them with any error. They were very zealous observers of the law of Moses, but held the traditions of the Pharisees in very great contempt.

Nazarite, when put to signify those under the ancient law who made a vow of observing a more than ordinary degree of purity (Numb. *ubi. cit.*), denotes a man or woman who engage themselves by a vow to abstain from wine and all intoxicating liquors, to let their hair grow without cutting or shaving, not to enter into any house that was polluted by having a dead corpse in it, nor to be present at any funeral. And if by chance any one should have died in their presence, they began again the whole ceremony of their consecration and Nazariteship. This ceremony generally lasted eight days, sometimes a month, and sometimes their whole lives. When the time of their Nazarite-

ship

Nazarite. ship was accomplished, the priest brought the person to the door of the temple, who there offered to the Lord a he lamb for a burnt-offering, a she lamb for an expiatory sacrifice, and a ram for a peace-offering. They offered likewise loaves and cakes, with wine necessary for the libations. After all this was sacrificed and offered to the Lord, the priest or some other shaved the head of the Nazarite at the door of the tabernacle, and burnt his hair, throwing it upon the fire of the altar. Then the priest put into the hand of the Nazarite the shoulder of the ram roasted, with a loaf and a cake, which the Nazarite returning into the hands of the priest, he offered them to the Lord, lifting them up in the presence of the Nazarite. And from this time he might again drink wine, his Nazariteship being now accomplished.

As to those that were perpetual Nazarites, as were Samson and John the Baptist, it appears that they were consecrated to their Nazariteship by their parents, and continued all their lives in this state without drinking wine or cutting their hair.

Those that made a vow of Nazariteship out of Palestine, and could not come to the temple when their vow was expired, contented themselves with observing the abstinence required by the law, and after that cutting their hair in the place where they were: as to the offerings and sacrifices prescribed by Moses, which were to be offered at the temple by themselves, or by others for them, they deferred this till they could have a convenient opportunity. Hence it was, that St Paul being at Corinth, and having made the vow of a Nazarite, he had his hair cut off at Cenchrea, and put off fulfilling the rest of his vow till he should arrive at Jerusalem, Acts xviii. 18. When a person found that he was not in a condition to make a vow of Nazariteship, or had not leisure to perform the ceremonies belonging to it, he contented himself by contributing to the expence of the sacrifice and offerings of those that had made and fulfilled this vow; and by this means he became a partaker in the merit of such Nazariteship. When St Paul came to Jerusalem, in the year of Christ 58, the apostle St James the Less, with the other brethren, said to him, Acts xxi. 23, 24. that to quiet the minds of the converted Jews, who had been informed that he everywhere preached up the entire abolition of the law of Moses, he ought to join himself to four of the faithful who had a vow of Nazariteship upon them, and contribute to the charge of the ceremony at the shaving of their heads; by which the new converts would perceive that he continued to keep the law, and that what they had heard of him was not true.

The Hebrew word *Nazir*, or Nazarite, which is made use of to express a man exalted to great dignity, as it is said of the patriarch Joseph, Gen. xlix. 26. and Deut. xxxiii. 16. "that he was separated from his brethren," as it is in our translation; or as the Vulgate and others understand the Hebrew, "that he was a Nazarite among his brethren," is variously understood. Some think that the Hebrew word נזיר, *Nazir*, in these places, signifies one who is crowned, chosen, separated, or distinguished: the word נזיר, *Nazir*, signifies a crown. The Septuagint translate this word a chief, or him that is honoured. Calmet thinks that this was a term of dignity in the courts of eastern princes, and that at this day in the court of Persia the word *Nazir* signifies the superintendant general of the king's household, the chief officer of the crown, the high steward of his family, treasures, and revenues; and that in this sense Joseph was the Nazir of the court of Pharoh. Le Clerc translates the *Nazir*, a prince, and calls Joseph "the prince of his brethren," in the two places already quoted. Mr Pool declares in favour of this last translation. See *Joseph. Chardin. Chrysost. St Jerome, &c.*

Nazarite || Neapolis.

NAZIANZEN. See *Gregory Nazianzen.*

NAZIM, the lord lieutenant, viceroy, or governor of a province in Hindostan; the same as *Subahdar*, or *Nabob.*

NEALED, among seamen, is used when the sounding is deep water close to the shore; as also when the shore is sandy, clayey, oozy, or foul and rocky ground.

NEALING, or rather Annealing, a term used for the preparing of several matters, by heating or baking them in the oven, or the like.

Nealing of glass, is the baking of glass, to dry, harden, and give it the due consistence, after it has been blown, and fashioned into the proper works.—This is usually performed in a kind of a tower called the *leer*, built over the melting furnace. See Glass.

Nealing of glass is also used for the art of staining glass with metalline colours. "One fine use of silver (says Mr Boyle) was only discovered since the art of annealing upon glass came to be practised. For prepared silver, or even the crude metal, being burnt on a glass plate, will tinge it of a fine yellow or golden colour. And there are several mineral earths, and other coarse matters, of use in this art, which by means of fire impart transparent colours to glass, and sometimes very different ones from those of the bodies themselves.

Nealing of steel, is the heating it in the fire to a blood-red heat, and then taking it out, and letting it cool gently of itself. This is done to make it softer, in order to engrave and punch upon it. See Tempering and Engraving.

Nealing is also used for the art or act of burning or baking earthen or other ware in an oven. The miners at Mendip, when they meet with a rock they cannot cut through, anneal it by laying on wood and coal, and contriving the fire so that they quit the mine before the operation begins, it being dangerous to enter it again before it be quite cleared of the smoke.

Nealing of tile is used in ancient statutes for the burning of tile. The word is formed of the Saxon *onælan*, *accendere*, to light, burn.

NEAP or Neep tides, are those tides which happen when the moon is in the middle of the second and fourth quarters. The neap tides are low tides, in respect of their opposites the spring tides. As the highest of the spring tides is three days after the full or change, so the lowest of the neap is four days before the full or change. On which occasion the seamen say that it is deep neap.

NEAPED. When a ship wants water, so that she cannot get out of the harbour, off the ground, or out of the dock, the seamen say she is *neaped*, or *beneaped.*

NEAPOLIS, in *Ancient Geography*, a city of the Higher Egypt, in the Nomos Panopolitanus, between Thebæ to the south, and Panopolis to the north, on the east side of the Nile; otherwise called *Cuane.* A

Neapolis || Necessity.

second Neapolis of Babylonia, situated near the Euphrates on the south side.—A third of Campania, an ancient town and a colony from Cumæ. (See Velleius, Pliny, Strabo); accounted a Greek city, and a great stickler for Greek usages, (See Livy, Tacitus). Its hot baths were in nothing inferior to those of Baiæ, according to Strabo; at two miles distance from it stands the monument of Virgil, held in religious veneration by learned posterity. The Younger Pliny relates, that Virgil's birth day was more religiously observed by Silius Italicus than his own, especially at Naples, where he resorted to his tomb as to a temple. The city is washed by the river Sebethus. Virgil feigns the nymph Sebethis to preside over the stream. Now *Naples*, capital of the kingdom of that name. See NAPLES.—A fourth, Neapolis of Caria, near the Meander, (Ptolemy).—A fifth, an inland town of Cyrenaica, situated between Ptolemais and Arsinoe, (Ptolemy); and to be distinguished from the Cænopolis, or Neapolis, on the east border of the same province, (id.) A sixth of Ionia, (Strabo); which belonged first to the Ephesians, but afterwards to the Samians, who exchanged Marathesium, a more distant city, for a nearer.—A seventh, Neapolis of Macedonia Adjecta, situated at the distance of 12 miles to the east of Philippi, (Antonine).—An eighth, Neapolis of Pisidia, on the borders of Galatia, situated between Amblada and Pappa, (Ptolemy).—A ninth of Samaria, the ancient *Sichem*, which see; so called upon its restoration by the Romans, (Coin, Pliny, Josephus).—A tenth of Sardinia, situated on the south-west side of the island, 30 miles to the north of Metalla; now called *Neapoli*.—An eleventh, of the Regio Syrtica, called also *Leptis*.—A twelfth, of Zeugitana on the Mediterranean, to the east of Clypea, and south of the Promontorium Mercurii.

NEAT or *Net Weight*, the weight of a commodity alone, clear of the cask, bag, case, or even filth. See NET.

NEBEL, or NABLUM, a musical instrument among the Jews. See NABLUM.

NEBIO, or NEBBIO, a ruined city, on the north side of the island of Corsica, with a bishop's see, whose bishop resides at San Fiorenzo, from which it is a mile distant.

NEBO, in *Ancient Geography*, a very high mountain, a part of the mountains of Abarim, and their highest top, whither Moses was ordered to ascend to take a view of the land of Canaan, and there die. Situated in the land of Moab over against Jericho: with a cognominal town at its foot (Isaiah) belonging to the Reubenites, which afterwards returned to the Moabites; in Jerome's time desolate; eight miles to the south of Heshbon.

NEBO, or *Nabo*. See NABO.

NEBUCHADNEZZAR. See NABUCHADNEZZAR.

NEBULY, or NEBULEE, in *Heraldry*, is when a coat is charged with several little figures, in form of words running within one another, or when the outline of a bordure, ordinary, &c. is indented or waved.

NECESSITY, whatever is done by a cause or power that is irresistible; in which sense it is opposed to freedom. Man is a necessary agent, if all his actions be so determined by the causes preceding each action, that not one past action could possibly not have come to pass, or have been otherwise than it hath been; nor one future action can possibly not come to pass, or be otherwise than it shall be. But he is a free agent, if he be able, at any time, under the circumstances and causes he then is, to do different things; or, in other words, if he be not unavoidably determined in every point of time, by the circumstances he is in, and the causes he is under, to do that one thing he does, and not possibly to do any other thing. Whether man is a necessary or a free agent, is a question which has been debated with much ingenuity by writers of the first eminence, from Hobbes and Clarke, to Priestley and Gregory. See METAPHYSICS, Part III. chap. v. and PREDESTINATION. Necessity.

NECESSITY, in *Mythology*, a power superior to all other powers, and equally irresistible by gods and by men. Heredotus, as he is quoted by Cudworth, mentions an oracle which declared that "God himself could not shun his destined fate." And among the fragments of Philemon collected by Le Clerc, is the following sentence:

Δουλοι βασιλεων εσμεν, οι βασιλεις θεων, ὁ θεος αναγκης.

"We are subject to kings, kings to the gods, and God to Necessity." Hence it is, that, in the Iliad, we find Jove himself, the sire of gods and men, regretting that, he was restrained by *Necessity* from rescuing his favourite son from the sword of Patroclus. Nay to such a height was this impiety carried in the earliest ages of Greece, that we find Hesiod and Homer teaching that the gods themselves were generated by *Necessity*, of Night and Chaos.

This power, though always represented as blind and unintelligent, was however worshipped as a goddess, bearing in her hand large iron nails, wedges, anchors, and melted lead *, as emblems of the inflexible severity of her nature. "In the city of Corinth she had a temple, in which the goddess *Violence* likewise resided, and into which no person was ever permitted to enter but the priest who officiated *in sacris* †."

* *Horace*, lib. i. ode 35.

† *Pausanias in Corinth.* cap. iv.

Learned men have exercised their ingenuity in vain attempts to trace this portentous notion to its origin. Some, who wished to interpret it in a pious sense, have supposed that the gods who are subject to *Necessity* were only those who were the ministers of the supreme *numen*; and that by *necessity* itself was meant nothing more than divine providence. But this is not consistent with Hesiod and Homer's Generation of the Gods, or with the epithets *sæva necessitas*, *dura necessitas*, by which this power was perpetually distinguished. Others, and among them Mosheim, have supposed that this monstrous fable was invented by the Pagan priests, and diligently inculcated upon the minds of the people, in order to excuse the villanies of the objects of their worship. For, says he, who could be indignant at Jupiter's numberless adulteries, after it was known that in all his actions he was the servant of blind necessity: In the thefts of *Mercury*, the whoredoms of *Venus*, and the frequent squabbles of the other gods, there could be no moral turpitude, if they were under the influence of a superior power.

Numina cum videas duris obnoxia fatis.
Invidia possis exonerare deos ‡.

‡ *Martial. Epigram.* lib. ix. N. 88. Ed. Amstel.

This 1701.

Necessity. This account of the matter is at least as plausible as any other which is usually given; but the real case undoubtedly was, that when men "did not like to retain God in their knowledge, God gave them over to a reprobate mind to do those things which are not convenient; when their foolish heart was darkened, and professing themselves to be wise, they became fools." See PARCÆ.

NECESSITY, in *Law*, as it implies a defect of will, excuses from the guilt of crimes. See CRIME.

Compulsion and inevitable *necessity* are a constraint upon the will, whereby a man is urged to do that which his judgment disapproves; and which, it is to be presumed, his will (if left to itself) would reject. As punishments are therefore only inflicted for the abuse of that free will which God has given to man, it is highly just and equitable that a man should be excused for those acts which are done through unavoidable force and compulsion.

1. Of this nature, in the first place, is the obligation of *civil subjection*, whereby the inferior is constrained by the superior to act contrary to what his own reason and inclination would suggest: as when a legislator establishes iniquity by a law, and commands the subject to do an act contrary to religion or sound morality. How far this excuse will be admitted *in foro conscientiæ*, or whether the inferior in this case is not bound to obey the divine rather than the human law, it is not our business to decide; though among the casuists, it is believed the question will hardly bear a doubt. But, however that may be, obedience to the laws in being is undoubtedly a sufficient extenuation of civil guilt before the municipal tribunal. The sheriff who burnt Latimer and Ridley, in the bigotted days of Queen Mary, was not liable to punishment from Elizabeth for executing so horrid an office; being justified by the commands of that magistracy which endeavoured to restore Superstition, under the holy auspices of its merciless sister, Persecution.

As to persons in private relations, the principal case where constraint of a superior is allowed as an excuse for criminal misconduct, is with regard to the matrimonial subjection of the wife to her husband: for neither a son nor a servant are excused from the commission of any crime, whether capital or otherwise, by the command or coercion of the parent or master; though in some cases the command or authority of the husband, either express or implied, will privilege the wife from punishment, even from capital offences. And therefore, if a woman commit theft, burglary, or other civil offences against the law of society, by the coercion of her husband, or even in his company, which the law construes a coercion, she is not guilty of any crime; being considered as acting by compulsion, and not of her own will. This doctrine is at least 1000 years old in this kingdom, being to be found among the laws of King Ina the West Saxon. And it appears, that among the northern nations on the continent, this privilege extended to any woman transgressing in concert with a man, and to any servant that committed a joint offence with a freeman: the male or freeman only was punished, the female or slave dismissed; *procul dubio quod alterum libertas, alterum necessitas impelleret.* But (besides that, in our law, which is a stranger to slavery, no impunity is given to servants, who are as much free agents as their masters) even with regard to wives, this rule admits of an exception in crimes that are *mala in se*, and prohibited by the law of nature; as murder, and the like: not only because these are of a deeper dye, but also, since in a state of nature no one is in subjection to another, it would be unreasonable to screen an offender from the punishment due to natural crimes, by the refinements and subordinations of civil society. In treason also (the highest crime which a member of society can, as such, be guilty of), no plea in coverture shall excuse the wife; no presumption of the husband's coercion shall extenuate her guilt; as well because of the odiousness and dangerous consequence of the crime itself, as because the husband, having broken through the most sacred tie of social community by rebellion against the state, has no right to that obedience from a wife, which he himself as a subject has forgotten to pay. In inferior misdemeanours also, we may remark another exception, that a wife may be indicted and set in the pillory with her husband, for keeping a brothel: for this is an offence touching the domestic economy or government of the house, in which the wife has a principal share; and is also such an offence as the law presumes to be generally conducted by the intrigues of the female sex. And in all cases where the wife offends alone, without the company or coercion of her husband, she is responsible for her offence as much as any femme-sole.

2. Another species of compulsion or necessity is what our law calls *duress per minas;* or threats and menaces, which induce a fear of death or other bodily harm, and which take away for that reason the guilt of many crimes and misdemeanours, at least before the human tribunal. But then that fear which compels a man to do an unwarrantable action ought to be just and well grounded; such, "*qui cadere possit in virum constantem, non timidum et meticulosum,*" as Bracton expresses it in the words of the civil law. Therefore in time of war or rebellion, a man may be justified in doing many treasonable acts by compulsion of the enemy or rebels, which would admit of no excuse in the time of peace. This, however, seems only, or at least principally, to hold as to positive crimes, so created by the laws of society, and which therefore society may excuse; but not as to natural offences, so declared by the law of God, wherein human magistrates are only the executioners of divine punishment. And therefore though a man be violently assaulted, and hath no other possible means of escaping death but by killing an innocent person, this fear and force shall not acquit him of murder; for he ought rather to die himself than escape by the murder of an innocent. But in such a case he is permitted to kill the assailant; for there the law of nature, and self-defence its primary canon, have made him his own protector.

3. There is a third species of necessity, which may be distinguished from the actual compulsion of external force or fear; being the result of reason and reflection, which act upon and constrain a man's will, and oblige him to do an action which without such obligation would be criminal. And that is, when a man has his choice of two evils set before him, and being under a necessity of choosing one, he chooses the least pernicious

Necessity. pernicious of the two. Here the will cannot be said freely to exert itself, being rather passive than active; or, if active, it is rather in rejecting the greater evil than in choosing the less. Of this sort is that necessity, where a man by the commandment of the law is bound to arrest another for any capital offence, or to disperse a riot, and resistance is made to his authority: it is here justifiable, and even necessary, to beat, to wound, or perhaps to kill the offenders, rather than permit the murderer to escape, or the riot to continue. For the preservation of the peace of the kingdom, and the apprehending of notorious malefactors, are of the utmost consequence to the public; and therefore excuse the felony, which the killing would otherwise amount to.

4. There is yet another case of necessity, which has occasioned great speculation among the writers upon general law; viz. whether a man in extreme want of food or clothing may justify stealing either, to relieve his present necessities. And this both Grotius and Puffendorff, together with many other of the foreign jurists, hold in the affirmative; maintaining by many ingenious, humane, and plausible reasons, that in such cases the community of goods, by a kind of tacit concession of society, is revived. And some even of our lawyers have held the same; though it seems to be an unwarranted doctrine, borrowed from the notions of some civilians; at least it is now antiquated, the law of England admitting no such excuse at present. And this its doctrine is agreeable not only to the sentiments of many of the wisest ancients, particularly Cicero, who holds, That *suum cuique incommodum ferendum est, potius quam de alterius commodis detrahendum;* but also to the Jewish law, as certified by King Solomon himself: "If a thief steal to satisfy his soul when he is hungry, he shall restore sevenfold, and shall give all the substance of his house:" which was the ordinary punishment for theft in that kingdom. And this is founded upon the highest reason: for men's properties would be under a strange insecurity, if liable to be invaded according to the wants of others; of which wants no man can possibly be an adequate judge but the party himself who pleads them. In England especially, there would be a peculiar impropriety in admitting so dubious an abuse: for by the laws such sufficient provision is made for the poor by the power of the civil magistrate, that it is impossible that the most needy stranger should ever be reduced to the necessity of thieving to support nature. The case of a stranger is, by the way, the strongest instance put to Baron Puffendorff, and whereon he builds his principal arguments: which, however they may hold upon the continent, where the parsimonious industry of the natives orders every one to work or starve, yet must lose all their weight and efficacy in England, where charity is reduced to a system, and interwoven in our very constitution. Therefore our laws ought by no means to be taxed with being unmerciful, for denying this privilege to the necessitous; especially when we consider, that the king, on the representation of his ministers of justice, hath a power to soften the law, and to extend mercy in cases of peculiar hardship. An advantage which is wanting in many states, particularly those which are democratical: and these have in its stead introduced and adopted, in the body of the law itself, a multitude of circumstances tending to alleviate its rigour. But the founders of our constitution thought it better to vest in the crown the power of pardoning particular objects of compassion, than to countenance and establish theft by one general undistinguishing law. Necessity || Neck.

NECHO, king of Egypt, began his reign 690 B. C. and was killed eight years after by Sabacon king of Ethiopia. Psammiticus his son succeeded him, and was the father, as Herodotus informs us, of Necho II. who reigned in the 616 B. C. This Necho II. is celebrated in history for attempting, though in vain, to cut a canal from the Nile to the Arabian gulf. He carried his arms as far as the Euphrates, and conquered the city of Carchemish. This prince is not only known in Scripture under the name of *Necho*, but also in profane history. He no sooner succeeded to the crown than he raised great land armies, and fitted out vast fleets, as well upon the Mediterranean as upon the Red sea: he gave battle to the Syrians near the city of Migdol; routed them, and made himself master of the city of Cadytis. The learned, however, are not agreed about this city Cadytis. Some will have it to be Cades in Arabia Petræa, others Jerusalem; and others say it is the city of Cedes, or Kedesh, in Galilee, in the tribe of Naphtali.

The Scriptures aquaint us with the whole expedition of Neeho in all its particulars, 2 Kings xxiii. 29. &c. and 2 Chr. xxxv. 20, 21, &c. In the year of the world 3394, this prince having drawn out his army into the field to make war with the Assyrians or Babylonians, and to take the city of Carchemish, otherwise called *Circusium*, upon the Euphrates, Josiah king of Judah, who was a tributary to the king of Babylon, marched to oppose his passage. Necho, who had no designs against him, sent to tell him, "What have I to do with you, king of Judah? It is not against you that I am come forth, but against another people, against whom the Lord has commanded me to make war. Leave off therefore to set yourself against me, for fear the Lord should punish you for your resistanec." But Josiah would not hearken to the remonstrances of Necho, but gave him battle at Megiddo, where he received the wound of which he died. The people of Jerusalem set up Jehoahaz for king of Judah, and Necho soon passed forward, without making any longer stay in Judea.

But at his return from his expedition, which was very successful, he halted at Riblah in Syria; and sending for Jehoahaz king of the Jews, he deposed him, loaded him with chains, and sent him into Egypt. Then coming to Jerusalem, he set up Eliakim, or Jehoiakim, in his place, and exacted the payment of 100 talents of silver and one talent of gold from the country. Jeremiah (xlvi. 2.) acquaints us that the city of Carchemish was taken from Necho by Nebuchadnezzar king of Babylon, in the fourth year of Jehoiakim king of Judah; so that Necho did not enjoy his conquest above four years. Josephus adds, that the king of Babylon pursuing his victory, brought under his dominion all the country which is between the Euphrates and Egypt, excepting Judea. Thus Necho was again reduced within the limits of his own country.

NECK, in *Anatomy*, is the slender part situated between

Neck || Necromancy.

tween the head and trunk of the body. See ANATOMY.

NECROLIUM, a word used by some of the alchemical writers to express a remedy almost always capable of averting death, and continuing life to its utmost period.

NECROLOGY, *necrologium*, formed of νεκρος, "dead," and λογος, "discourse or enumeration," a book anciently kept in churches and monasteries, wherein were registered the benefactors of the same, the time of their deaths, and the days of their commemoration; as also the deaths of the priors, abbots, religious, canons, &c. This was otherwise called *calender* and *obituary*.

NECROMANCY, the art of revealing future events by a pretended communication with the dead.

This superstitious and impious imposture appears to have had its origin at a very early period in Egypt, and to have been thence propagated in every nation with the manners of which history has made us acquainted. The conquests of Sesostris might introduce it into India; the Israelites would naturally borrow it from the people among whom they sojourned 400 years; and it would easily find its way into Phœnicia, from the vicinity of that country to the land of its nativity. From the Egyptians and Phœnicians it was adopted, with the other rites of paganism, by the Greeks; and it was imported into Rome with Grecian literature and Grecian manners. It was not however confined to the pagan nations of antiquity: it spread itself through all the modern nations of Europe, and took such deep root as to be long retained even after those nations were converted to the Christain faith.

Of its early antiquity we have complete evidence in the writings of Moses, where it is severely condemned as an abomination to the Lord *; and though it appears to have been even then spread into Phœnicia, we might yet conclude its birthplace to have been Egypt, because, at their *exody*, the Israelites were corrupted only by Egyptian superstitions, and because necromancy seems to be one of those whoredoms which the prophet Ezekiel represents his countrymen as having brought with them from Egypt, and continued to practise till they were carried captives into Babylon.

* Deut. xviii. 10, 11, 12.

If from sacred we proceed to consult profane authors, we shall find them not only affirming Egypt to have been the birthplace of necromancy, but in some degree accounting for the origin of so impious a delusion. From Diodorus the Sicilian † we learn that the Grecian fable of *Charon* the ferryman of hell, of *Styx*, *Cocytus*, the *Elysian Fields*, *Tartarus*, the judgment of *Minos* and *Rhadamanthus*, &c. with the whole scenery of the infernal regions, were imported from Egypt into Greece. The ancient Egyptians, and indeed all the people of the east, made use of caves for burying places, which were well suited to the solemn sadness of the surviving friends, and proper receptacles for those who were never more to behold the light. In Egypt, many of those subterraneous cavities being dug out of the natural rock, still remain, and command the admiration of travellers; and near to the pyramids in particular there are some apartments of a wonderful fabric, which though they extend in length 4400 feet, and are about 30 feet in depth, appear to have been, if not entirely dug, at least reduced to form by the chissel or pickaxe of the artist.

† Lib. i. § 2.

Necromancy

From the practice of burying in such caverns sprung the opinion that the infernal mansions were situated somewhere near the centre of the earth, which by the Egyptians was believed to be not very distant from its surface ‡. In these dreary mansions, it was very easy for such adepts as the priests of Egypt to fabricate Erebus, Tartarus, the Elysian Fields, and all those scenes which were displayed before the initiated (see MYSTERIES), and by them described to the million of the people. As it was in those dark abodes that necromancy was practised, it would be no difficult matter for such magicians as withstood Moses to impose so far upon the credulous vulgar, as to make them believe, that in consequence of their invocations they actually saw the ghosts of their friends ascend out of the earth. It appears from the book of Exodus, that the Israelitish women were, even in the wilderness, well acquainted with the use of the mirror, which was therefore undoubtedly known to the Egyptians. But a mirror of a particular form and properly illuminated at the instant required, might be easily made to reflect, in a cavern from which all other light was carefully excluded, the image of the deceased, who was called upon by the necromancer; and we can readily conceive, that with respect to the question to be proposed, a person might be concealed, prepared to give such ambiguous answers as would satisfy the inquirer, and at the same time save the credit of the oracle. The terrified imaginations of the spectators would aid the delusion, and make a very slight resemblance pass for the ghost or ειδωλον of their departed friend; or the necromancer might assign plausible reasons why a spectre, after having dwelt for some time in the infernal regions, should lose something of its resemblance to the body which it animated. Such juggling tricks, though performed by artists less accomplished than Jannes and Jambres, have gained credit among people much more enlightened than the Egyptians can possibly have been when the science of necromancy was invented by their priests.

‡ *Bryant's Analysis of Mythology.*

That the Israelites, notwithstanding the prohibition of their legislator, continued to practise the rites of necromancy, is apparent from Saul's transaction with the witch of Endor (see MAGIC). From the same transaction, it is likewise apparent that the witches of Israel, and therefore in all probability the necromancers of Egypt, pretended to evocate the ghosts of the dead by a *demon* or *familiar spirit*, which they had at their command to employ upon every emergency. This demon was called OB; and therefore Saul desires his servants to find him a woman who was mistress of an OB (A).

It

(A) The original, or radical, signification of this word occurs, in Job xxxii. ver. 19.; where Elihu compares his belly to new bottles, which he calls *oboth*, the plural of *ob*. But as bottles were then made of leather, new bottles filled with wine and ready to burst, as Elihu describes them, would of course be of a form nearly globular.

Necromancy. It is probable that those wretched impostors had in their pay some persons who occasionally acted the part of the demon, and when the execution of the plot required their agency, emitted, by means of a cavity dug for that purpose, a low hollow voice from below the ground. Hence we find Isaiah, in his denunciations against Ariel *, saying, "Thou shalt be brought down, and shalt speak out of the ground; and thy speech shall be low out of the dust, and thy voice shall be as of one that hath a familiar spirit (an OB) out of the ground, and thy speech shall whisper out of the dust."

* Chap. xxix. 4.

But though the Egyptian priests were undoubtedly the inventors of the whole mystery of necromancy, and though it was from them imported into Greece by the SELLI or priests of Dodona, it does not appear that the Grecian necromancers pretended to be masters of OBS or familiar spirits. Mopsus, Orpheus, Linus, Eumolpus, &c. who either travelled into Egypt in quest of knowledge, or were actually natives of that country, instructed the early Greeks in this occult science: but whatever might be the practice of these apostles themselves, their disciples professed to do all the feats of magic by performing certain rites, by offering certain sacrifices, by muttering a certain form of words, by charms, spells, and exorcisms. By these they pretended to evocate the dead as certainly as the Egyptians and Jews did by their *familiar spirits*. By a small display of critical learning this might be easily proved from the popular story of Orpheus and Eurydice, which certainly was founded on one of these necromantic deceptions exhibited in a cave near Dodona, where the priests had a *hades* or infernal mansion, in humble imitation of those with which the first of them were well acquainted in Egypt. It is indeed evident, without the aid of criticism: no man of any letters is ignorant, that whatever superstitions of this kind prevailed among the Romans were borrowed from the Greeks. But we all know that Virgil makes one of his shepherds, by means of certain herbs, poisons, and senseless charms, raise up ghosts from the bottoms of their graves; and Lucian has fabricated a story of this kind, which may be considered as an exact parallel to the witch of Endor. Just before the battle of Pharsalia he makes † young Pompey travel by night to a Thessalian sorceress, and anxiously inquire of her the issue of the war. This female necromancer, by a tedious process of charms and incantations, conjures up the ghost of a soldier who had been lately slain. The phantom, after a long preamble, denounces a prediction much of the same kind with that which the king of Israel received from Samuel at Endor; and though we have elsewhere shown, that nothing but the spirit of God could have foreseen the inevitable destruction of Saul, his sons, and his army, (see MAGIC), it was very easy for any man of tolerable sagacity to foresee the defeat of Pompey's raw and undisciplined troops by the hardy veterans of the victorious Cæsar.

† Lib. vi. ver. 570. et seq.

Necromancy.

It would be endless to enumerate all the fallacious evocations of ghosts, and the ambiguous responses returned by those pretended spirits, of which we have accounts from the poets and historians of the celebrated nations of antiquity. We shall therefore proceed to mention a few which occur in the fabulous history of more modern nations, and then leave the subject to the meditation of our readers. In Mallet's Northern Antiquities, we have the following account of a necromantic exploit, between which, and the descent of the ancient heroes into hell, it is impossible not to remark a striking similitude.

"Odin the sovereign of man arises. He saddles his horse Sleipner; he mounts, and is conveyed to the subterraneous abode of *Hela*. The dog which guards the gates of death meets him. His breast and his jaws are stained with blood. He opens his voracious mouth to bite, and barks a long time at the father of magic. Odin pursues his way; and the infernal cavern resounds and trembles under his horse's hoofs. At length he reaches the deep abode of death, and stops near the eastern gate, where stands the tomb of the prophetess. He sings with a voice adapted to call up the dead; he looks towards the world; he engraves Runic characters on her tomb; he utters mysterious words; and he demands an answer, until the prophetess is constrained to arise and thus utter the words of the dead.—"Who is this unknown that dares to disturb my repose, and drag me from the grave, in which I have been dead so long, all covered with snow, and moistened with the rains?" &c.

The Gaelic druids pretended to be masters of the same secret. This is evident from the name of a species of divination, not uncommon among the Scotch Highlanders so lately as in the beginning of the 18th century. By a gentleman excellently versed in the antiquities of that people, and a steady friend to the writer of this article, we have been informed, that not many years ago some of the Highlanders relied implicitly upon certain oracular responses, called in their language *taghairm*. This word seems to be compounded of *ta*, which in some parts of the Highlands is still used to denote a spirit or ghost, and *ghairm*, which signifies *calling upon* or invoking. *Taghairm*, therefore, in its original import, is *necromancy* in the most proper sense of that word.

There were different kinds of *taghairm*, of which one was very lately practised in *Skye*. The diviner covered himself with a cow's hide, and repaired at night to some deep-sounding cave, whither the person who consulted

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lar. Hence it may be inferred that the original import of *ob* was *round* or *globular:* but *b* and *p* being labials, are often changed into each other; and therefore, from the Hebrew *ob* is derived the Greek οψ, *oculus*, οπομαι, *video*, and the Latin *ops*, a name under which the earth was worshipped. *Upis* was a name of Diana or the moon: the father of one of the Dianas was likewise *Upis;* but this *Upis* was undoubtedly the sun. Now the difference between *upis* and *opis* is nothing; hence we are led to believe, that as they are all derived from *ob*, this word was employed by the early idolaters of Egypt to denote the first and greatest of Pagan gods, the sun. If so, those wretches who pretended to be mistresses of *obs*, were exactly the same kind of impostors with the Pythonesses of the Greeks.

Necromancy. sulted him followed soon after without any attendants. At the mouth of the cave he proposed aloud the questions of which he wanted solutions; and the man within pronounced the responses in a tone of voice similar to that with which the OBS, or pretended demons of antiquity, gave from beneath the ground their oracular answers. That in the latter days of *taghairm*, the Gaelic diviners pretend to evocate ghosts, and from them to extort solutions of difficulties proposed, we have no positive evidence; but that such was the original pretence there can be little doubt, when we reflect either upon the place where this species of divination was practised, or upon the import of the word by which it was denominated.

As we have been led to mention *taghairm*, we shall beg leave to make a few observations on another species of it, called *taghairm an uisge*, or "*taghairm* by water." This too was last practised in the Isle of Skye, by a man of the name of *M'Cuidhean*, whose ancestors had long been famous for the art. He lived near a beautiful cascade on a small river; and when consulted on any matter of consequence, he covered his whole body with a cow's hide, that necessary implement of Highland divination, and placed himself between the water of the cascade and the rock over which it flowed. Then another man with a heavy pole gave repeated strokes to the water, and the diviner behind it crying out now and then in Gaelic, "Is this a stock o arn?" This operation was continued till M'Cuidhean was perceived to be frantic or furious, when he was considered as in a condition to answer the most important questions. He was frequently consulted about futurity; and though he could not, in the proper sense of the word, be called a *necromancer*, his responses were listened to as proceeding from something more than human. A degree of phrenzy, either real or affected, seems to have accompanied the predictions of certain kinds of diviners in all ages; and we cannot help remarking the similarity between the madness of M'Cuidhean and that of the Sibyl in the sixth book of the Æneid; though we cannot suppose the one to have been borrowed from the other.

At, Phœbi nondum patiens, immanis in antro
Bacchatur vates, magnum si pectore possit
Excussisse Deum: tanto magis ille fatigat
Os rabidum, fera corda domans, fingitque premendo.

Struggling in vain, impatient of her load,
And lab'ring underneath the pond'rous god;
The more she strove to shake him from her breast,
With more and far superior force he press'd.
DRYDEN.

That all these pretences, whether ancient or modern, to the power of divination by means of familiar spirits, or by the art of necromancy, were groundless as well as impious, it would be affronting the understandings of our readers to offer any proof. Under the article MAGIC we have said enough on the subject, and perhaps more than enough, to those who know that demons, if they have any existence, and the departed spirits of good and bad men, are all under the controul of Him who governs the intellectual as well as material world by fixed and equal laws.—These details of superstition, however, will not be useless, if, by showing how poor and wretched a creature man becomes when left to his own inventions, they shall make any one grateful for the benefits of good government, and the blessings of revealed religion. Necromancy || Nectarium.

NECROPOLIS, a suburb of Alexandria in Egypt. It signifies "the City of the Dead;" wherein there were temples, gardens, and superb mausoleums. Here Cleopatra is said to have applied the aspic to her breast, to prevent being led in triumph by Augustus, who endeavoured to save her.

NECROSIS, νεκρωσις, in *Medicine*, a complete mortification of any part; called also *sideratio* and *sphacelus*.

NECTANEBUS, or NECTANABIS, a king of Egypt, who defended his country against the Persians. His grandson of the same name made an alliance with Agesilaus king of Sparta, and with his assistance he quelled a rebellion of his subjects. Some time after he was joined by the Sidonians, Phœnicians, and inhabitants of Cyprus, who had revolted from the king of Persia. This powerful confederacy was soon attacked by Darius the king of Persia, who marched at the head of his troops. Nectanebus, to defend his frontiers against so dangerous an enemy, levied 20,000 mercenary soldiers in Greece, the same number in Libya, and 60,000 were furnished in Egypt. This numerous body was not equal to the Persian forces, and Nectanebus, defeated in a battle, gave up all hopes of resistance, and fled into Ethiopia, where he found a safe asylum. His kingdom of Egypt became from that time tributary to the king of Persia.

NECTAR, among ancient poets, the drink of the fabulous deities of the heathens; in contradistinction from their solid food, which was called *ambrosia*.

NECTARINE, a fruit differing in nothing from the common peach, of which it is a species, but in having a smoother rind and a firmer pulp. See PERSICA.

NECTARIUM, from *nectar*, the fabled "drink of the gods;" defined by Linnæus to be a part of the corolla, or appendage to the petals, appropriated for containing the honey, a species of vegetable salt under a fluid form, that oozes from the plant, and is the principal food of bees and other insects.

Notwithstanding this definition, which seems to consider the nectarium as necessary a part of the corolla as the petals, it is certain that all flowers are not provided with this appendage, neither indeed is it essential to fructification.

There is, besides, a manifest impropriety in terming the nectarium a part of the corolla. Linnæus might, with equal propriety, have termed it a part or appendage of the stamina, calyx, or pointal, as the appearance in question is confined to no particular part of the flower, but is as various in point of situation as of form. The truth is, the term *nectarium* is exceedingly vague; and, if any determinate meaning can be affixed to it, is expressive of all the singularities which are observed in the different parts of flowers. *Milne's Bot. Dict.*

The tube, or lower part of flowers with one petal, Linnæus considers as a true nectarium, because it is generally found to contain the sweet liquor formerly mentioned. This liquor Pontedera compares to that called *amnios* in pregnant animals, which enters the fertile or impregnated seeds: but that this is not at

Nectarium

least its sole use, is evident from this circumstance, that the honey or liquor in question is to be found in flowers where there are either no seeds, or those which, from the want of male organs, cannot be impregnated. Thus the male flowers of nettle and willow, the female flowers of sea-side laurel and black bryony, the male and female flowers of clutia, kiggelaria, and butcher's broom, all abound with the honey or nectar alluded to.

Vaillant was of opinion, that the nectarium was an essential part of the corolla; for which reason he distinguished the singular appearances in fennel flower and columbine by the name of *petals:* the coloured leaves which are now termed the *petals* he denominates the *flower cup.*

That the nectarium, however, is frequently distinct from the petals, is evident both from the well known examples just mentioned, as likewise from the flowers of monkshood, hellebore, isopyrum, fennel flower of Crete, barrenwort, grass of Parnassus, chocolate nut, cherleria, and sauvagesia.

These general observations being premised, we proceed to take a nearer and more particular view of the principal diversities, both in form and situation, of this striking appendage to the flower. 1. In many flowers the nectarium is shaped like a spur or horn; and that either in flowers of one petal, as valerian, water milfoil (*utricularia*), butterwort, and calves-snout; or in such as have more than one, as larkspur, violet, fumitory, balsam, and orchis. 2. In the following plants, the nectarium is properly a part of the corolla, as lying within the substance of the petals: ranunculus, lily, iris, crown imperial, water leaf, mouse tail, ananas, or pine apple, dog's-tooth violet, piperidge bush, vallisneria, hermannia, uvularia, and swertia. 3. The nectarium is frequently placed in a series or row within the petals, though entirely unconnected with their substance. In this situation it often resembles a cup, as in narcissus. A nectarium of this kind is said by Linnæus to crown the corolla. The following are examples: daffodil, sea daffodil, campion, viscous campion, swallow-wort, stapelia, cynanchum, nepenthes, cherleria, balsam-tree, African spiræa, witch-hazel, olax, and passion-flower. 4. In Indian-cress, buckler, mustard, Barbadoes cherry, and monotropa, the nectarium is situated upon or makes part of the calyx. 5. The nectarium in bastard flower-fence is seated upon the antheræ or tops of the stamina; whence the name *adenanthera*, or *glandular anthera*, which has been given to this genus of plants. In the following list it is placed upon the filaments; bean-caper, bay, fraxinella, marvel of Peru, bell-flower, lead-wort, roella, and commelina. 6. In hyacinth, flowering-rush, stock July flower, and rocket, the nectarium is placed upon the seed-bud. 7. In honey-flower, orpine, buckwheat, collinsonia, lathræa, navelwort, mercury, clutia, kiggelaria, sea-side laurel, and African spiræa, it is attached to the common receptacle. Lastly, In ginger, nettle, dyer's weed, heart seed, costus, turmeric, grewia, bastard orpine, vanelloe, shew-tree, and willow, the nectarium is of a very singular construction, and cannot properly fall under any of the foregoing heads.

In discriminating the genera, the nectarium often furnishes an essential character.

Plants which have the nectarium distinct from the petals, that is, not lodged within their substance, are affirmed by Linnæus to be generally poisonous. The following are adduced as examples: monkshood, hellebore, columbine, fennel-flower, grass of Parnassus, barren-wort, oleander, marvel of Peru, bean-caper, succulent swallow-wort, fraxinella, and honey-flower.

Nectarium || Needham

NECUIA, in *Botany*, a name given by the ancient Greeks to a species of mullein.

The Greeks and Romans both used the stalks of a peculiar kind of mullein, called *thryallis* by Nicander, for the making of wicks of lamps. We have a kind of mullein called *lychnites*, and candle-wick mullein, from the λυχνιτες of Dioscorides; but it is not certain that ours is the same plant.

The ancients used the stalks of many different plants for the wicks of their candles and lamps. The rush, stripped of its bark, was as commonly in use with them as with us for that purpose; and they also used the nettle, this mullein, and many other plants, whose stalks were composed of tough filaments, for the same purpose; beating them out like hemp, and when dry dipping them in melted resin, and other such inflammable substances. When thus prepared, they are readily inflammable, like our flambeau; and this mullein, having stalks more long and large, and more firm than all the others, was used to make those lights with which they set fire to the funeral pile, for consuming the ashes of their dead friends.

NECYDALIS, a genus of insects belonging to the order of coleoptera. See ENTOMOLOGY *Index.*

NEEDHAM, JOHN TUBERVILLE, was born at London the 10th of September in the year 1713. His parents were descended from ancient and noble families. His father, who had once possessed a considerable patrimony at Hilston, in the county of Monmouth, was of the younger and Catholic branch of the Needham family: the head of the elder and Protestant branch was Lord Kilmory, created viscount in the year 1625. The father of Mr Needham died young, and left but a small fortune to his four children. His eldest son, who is the subject of this article, prosecuted his studies under the secular clergy of the English college of Douay, where he took orders, taught rhetoric for several years, gave eminent proofs of sagacity and genius, and surpassed all the other professors of that seminary in the knowledge of experimental philosophy. In 1740, he was engaged by his superiors in the service of the English mission, and was entrusted with the direction of the school erected at Twyford, near Winchester, for the education of the Roman Catholic youth. In 1744, he was appointed professor of philosophy in the English college at Lisbon, where, on account of his bad health, he remained only 15 months. After his return, he passed several years at London and Paris, which were principally employed in microscopical observations, and in other branches of experimental philosophy. The results of these observations and experiments were published in the Philosophical Transactions of the Royal Society of London in 1749, and in a volume in 12mo at Paris in 1750; and an account of them was also given by M. de Buffon, in the first volumes of his Natural History. There was an intimate connexion between this illustrious French naturalist and Mr Needham: they made their experiments and observations together;

Needham, Needle.

gether; though the results and systems which they deduced from the same objects and operations were totally different. Mr Needham was admitted to a place in the Royal Society of London in the year 1747, and in the Antiquarian Society some time after. From the year 1751 to 1767 he was chiefly employed in finishing the education of several English and Irish noblemen, by attending them as tutor in their travels through France, Italy, and other countries. He then retired from this wandering life to the English seminary at Paris, and in 1768 was chosen by the Royal Academy of Sciences in that city a corresponding member.

When the regency of the Austrian Netherlands, in order to the revival of philosophy and literature in that country formed the project of an Imperial academy, which was preceded by the erection of a small literary society to prepare the way for its execution, Mr Needham was invited to Brussels by Count Cobentzel and the president Neny, and was appointed successively chief director of both these foundations. He held this place, together with some ecclesiastical preferments in the Low Countries, until his death, which happened the 30th of December 1781. "His piety, temperance, and purity of manners (we follow the expressions of the abbé Mann) were eminent: his attachment to the doctrines and duties of Christianity was inviolable. His zealous opposition to modern infidels was indefatigable, and even passionate. His probity was untainted. He was incapable of every species of duplicity; his beneficence was universal, and his unsuspicious candour rendered him often a dupe to perfidy." These and other good qualities the panegyrist attributes to his deceased friend; and the learned authors of the Monthly Review, to whom Mr Needham was known, admit the justness of the panegyrie. He was undoubtedly (say they), both an honest man and a worthy citizen; but though his death be a real loss to the literary world, yet he died seasonably for himself; for had he lived to see Joseph II. and the Great making so free with the paint, patches, and trinkets of the mother church, confiscating her lands, abolishing her convents, suppressing her holidays, introducing common sense into her worship, erecting political conductors to disperse the thunder of the Vatican, and achieving many other things in this style of improvement, it would have vexed full sore his feeling heart. For this honest man was narrow even to superstition and bigotry in his religious system; and we never knew a man in whom there was such an unaccountable mixture of implicit faith and philosophical curiosity as in Mr Needham. He was a keen and judicious observer of nature, had a peculiar dexterity in confirming his observations by experiments, and he was always occupied (sometimes indeed with too much fancy and precipitation) in generalizing facts, and reducing them to his system. "His pen (says Abbé Mann) was neither remarkable for fecundity nor method: his writings are rather the great lines of a subject expressed with energy, and thrown upon paper in a hurry, than finished treatises." His works are well known both in Britain and in France.

NEEDHAM, a town in Suffolk, 73 miles from London, stands on the Orwell, 9 miles from Ipswich. Its population in 1811 was 1301.

NEEDLE, a very common little instrument or utensil made of steel, pointed at one end, and pierced at the other, used in sewing, embroidery, tapestry, &c. Needle.

Needles make a very considerable article in commerce, though there is scarce any commodity cheaper, the consumption of them being almost incredible.—The sizes are from N° 1. the largest, to N° 25, the smallest. In the manufacture of needles, German and Hungarian steel is of most repute.

In the making of them, the first thing is to pass the steel through a coal fire, and under a hammer, to bring it out of its square figure into a cylindrical one. This done, it is drawn through a large hole of a wire-drawing iron, and returned into the fire, and drawn through a second hole of the iron smaller than the first; and thus successively from hole to hole, till it has acquired the degree of fineness required for that species of needles; observing every time it is to be drawn, that it be greased over with lard, to render it more manageable. The steel, thus reduced to a fine wire, is cut in pieces of the length of the needles intended. These pieces are flattened at one end on the anvil, in order to form the head and eye: they are then put into the fire to soften them farther; and thence taken out and pierced at each extreme of the flat part on the anvil, by force of a puncheon of well-tempered steel, and laid on a leaden block to bring out, with another puncheon, the little piece of steel remaining in the eye. The corners are then filed off the square of the heads, and a little cavity filed on each side of the flat of the head; this done, the point is formed with a file, and the whole filed over: they are then laid to heat red hot on a long narrow iron, crooked at one end, in a charcoal fire; and when taken out thence, are thrown into a bason of cold water to harden. On this operation a good deal depends; too much heat burns them, and too little leaves them soft; the medium is learned by experience. When they are thus hardened, they are laid in an iron shovel, on a fire more or less brisk in proportion to the thickness of the needles; taking care to move them from time to time. This serves to temper them, and take off their brittleness; great care here too must be taken of the degree of heat. They are then straightened one after another with the hammer, the coldness of the water used in hardening them, having twisted the greatest part of them.

The next process is the polishing them. To do this, they take 12,000 or 15,000 needles, and range them in little heaps against each other on a piece of new buckram sprinkled with emery dust. The needles thus disposed, emery dust is thrown over them, which is again sprinkled with oil of olives; at last the whole is made up into a roll, well bound at both ends. This roll is then laid on a polishing table, and over it a thick plank loaded with stones, which two men work backwards and forwards a day and a half, or two days, successively; by which means the roll thus continually agitated by the weight and motion of the plank over it, the needles withinside being rubbed against each other with oil and emery, are insensibly polished. After polishing they are taken out, and the filth washed off them with hot water and soap: they are then wiped in hot bran, a little moistened, placed with the needles in a round box, suspended in the air by a cord, which is kept stirring till the bran and needles be dry. The needles thus wiped in two or three different brans,

Needle. are taken out and put in wooden vessels, to have the good separated from those whose points or eyes have been broken either in polishing or wiping; the points are then all turned the same way, and smoothed with an emery stone turned with a wheel. This operation finishes them, and there remains nothing but to make them into packets of 250 each. Needles were first made in England by a native of India, in 1545, but the art was lost at his death; it was, however, recovered by Christopher Greening in 1560, who was settled with his three children, Elizabeth John, and Thomas, by Mr Damar, ancestor of the present Lord Milton, at Long Crendon in Bucks, where the manufactory has been carried on from that time to the present day.

Plate CCCLXIX. fig. 1. *Dipping-Needle*, or *Inclinatory Needle*, a magnetical needle, so hung, as that, instead of playing horizontally, and pointing out north and south, one end dips, or inclines to the horizon, and the other points to a certain degree of elevation above it.

The dipping-needle was invented in the year 1576, by one Robert Norman, a compass-maker at Wapping. The occasion of the discovery, according to his own account, was, that it being his custom to finish and hang the needles of his compasses before he touched them, he always found, that immediately after the touch, the north-point would bend or incline downward, under the horizon; insomuch that, to balance the needle again, he was always forced to put a piece of wax on the south end as a counterpoise. The constancy of this effect led him at length to observe the precise quantity of the dip, or to measure the greatest angle which the needle would make with the horizon; and this at London he found to be 71° 50′. In 1723 Mr Graham made a great many observations on the dipping-needle, and found the angle to be between 74 and 75 degrees. Mr Nairn, in 1772 found it to be somewhat above 72°. It is not certain whether the dip varies, as well as the horizontal direction, in the same place. The trifling difference between Mr Norman and Mr Nairne would lead us to imagine that the dip was unalterable; but Mr Graham, who was a very accurate observer, makes the difference more considerable. It is certain, however, from a great number of experiments and observations that the dip is variable in different latitudes, and that it increases in going northwards. It appears from a table of observations made with the marine dipping-needle in a voyage towards the north pole in 1733, that in lat. 60. 18. the dip was 75°; and in lat. 70. 45. it was 77° 52′; in lat. 80. 12. it was 81° 52′; and in lat. 80. 27. it was 82° 2½′.

Several authors have endeavoured to apply this discovery of the dip to the finding of the latitude; and Mr Bond attempted to apply it to the finding of the longitude also; but for want of observations and experiments he could not make any progress. The affair was farther prosecuted by Mr Whiston, who published a treatise on the longitude, and for some time imagined it was possible to find it exactly by means of the dip of the needle: yet he at last despaired of it, for the following reasons; 1. The weakness of the magnetic power. 2. The concussion of the ship, which he found it exceedingly difficult to avoid so much as was necessary for the accuracy of the experiments. 3. The principal objection was an irregularity in the motions of all magnetic needles, both horizontal and dipping, by which they, within the compass of about a degree, vary uncertainly backward and forward; even sometimes in a few hours time, without any evident cause. For a particular account of these variations, both of the horizontal and dipping needle, see the article VARIATION. Needle.

Mr Nairne made a dipping needle in 1772 for the Board of Longitude, which was used in the voyage towards the north pole. This is represented at fig. 2. Fig. 2. The needle AA is 12 inches long, and its axis, the ends BB of which are made of gold, alloyed with copper, rests on friction wheels CCCC, of four inches diameter, each end on two friction wheels; which wheels are balanced with great care. The ends of the axis of the friction wheels are likewise of gold alloyed with copper, and moved in small holes made in bell metal; and opposite to the ends of the axes of the needle and the friction wheels, are flat agates, set in at DDD, finely polished. The magnetic needle vibrates within a circle of bell metal, EEE, divided into degrees and half degrees; and a line, passing through the middle of the needle to the ends, points to the divisions. The needle of this instrument was balanced before it was made magnetical; but by means of a cross, the ends of which are FFFF, (contrived by the reverend Mr Mitchell) fixed on the axis of the needle, on the arms of which are cut very fine screws to receive small buttons, that may be screwed nearer or farther from the axis, the needles may be adjusted both ways to a great nicety, after being made magnetical, by reversing the poles, and changing the sides of the needle. GG are two levels, by which the line of 0 degrees of the instrument is set horizontal, by means of the four adjusting screws LLLL; H is the perpendicular axis, by which the instrument may be turned, that the divided face of the circle may front the east or west; to this axis may be fixed an index I, which points to an opposite line on the horizontal plate K when the instrument is turned half round; MMMM are screws which hold the glass cover to keep the needle from being disturbed by the wind. When this needle is constructed for sea, it is suspended by an universal joint on a triangular stand, and adjusted vertically by a plumb line and button above the divided circle and the dovetail work at the upper 90; and the divisions on the circle are adjusted so as to be perpendicular to the horizon by the same plumb line, and an adjoining screw; and when it is adjusted, a pointer annexed to a screw, which serves to move the divided circle, is fixed at the lowest 90. Whenever the instrument is used to find the dip, it must be so placed that the needle may vibrate exactly in the magnetic meridian.

Magnetical Needle, in *Navigation*, a needle touched with a loadstone, and sustained on a pivot or centre; on which playing at liberty, it directs itself to certain points in or under the horizon; whence the magnetical needle is of two kinds, viz. horizontal or inclinatory. See the article MAGNET.

Horizontal needles are those equally balanced on each side of the pivot that sustains them, and which, playing horizontally with their two extremes, point out the north and south points of the horizon. For their application and use, see the article COMPASS.

In the construction of the horizontal needle, a piece of pure steel is provided; of a length not exceeding six inches,

Needle. inches, lest its weight should impede its volubility; very thin, to take its vertieity the better; and not piereed with any holes, or the like, for ornament sake, which prevent the equable diffusion of the magnetie virtue. A perforation is then made, in the middle of its length, and a brass cap or head soldered on, whose inner cavity is conieal, so as to play freely on a style or pivot headed with a fine steel point. The north point of the needle in our hemisphere is made a little lighter than the southern; the touch always destroying the balance, if well adjusted before, and rendering the north end heavier than the south, and thus oeeasioning the needle to dip.

The method of giving the needle its vertieity or directive faculty has been shown already under the artiele MAGNET; but if, after touehing, the needle be out of its equilibrium, something must be filed off from the heavier side, till it halanee evenly.

Needles in sea compasses are usually made of a rhomboidal or oblong form; we have given their structure already under the artiele COMPASS.

The needle is not found to point preeisely to the north, except in very few places; but deviates from it more or less in different places, and that too at different times; which deviation is ealled its *declination* or *variation from the meridian*. See the article VARIATION.

Surgeons NEEDLES are generally made crooked, and their points triangular; however, they are of different forms and sizes, and bear different names, according to the purposes they are used for.

The largest are needles for amputation; the next, needles for wounds; the finest, needles for sutures. They have others, very short and flat, for tendons; others, still shorter, and the eye placed in the middle, for tying together of vessels, &c. Needles for eouehing cataracts are of various kinds; all of which have a small, broad, and sharp point or tongue, and some with a sulcus at the point. Surgeons have sometimes used two needles in this operation; one with a sharp point for perforating the coats of the eye, and another with a more obtuse point for depressing or eouehing the opaque crystalline lens; but eare should be taken in the use of any of these, that they be first well polished with cloth or leather, before they are applied to the eye.

Mr Warner observes, that the blade of the eouehing needle should be at least a third part larger than those generally used upon this oeeasion, as great advantages will be found in the depressing of the cataract, by the increased breadth of the blade of that instrument. The handle, also, if made somewhat shorter than usual, will enable the operator to perform with greater steadiness than he can do with a larger handled instrument.

It is to be observed, that needles of silver pierce more easily in stitching arteries after an amputation, than those made of steel.

NEEDLE Fish. See SYNGNATHUS, ICHTHYOLOGY *Index*.

NEEDLES, sharp pointed rocks north of the isle of Wight. They are situated at the western extremity of the island, which is an aeute point of high land, from which they have been disjoined by the washing of the sea. There were of these lofty white rocks formerly three, but about 14 years ago the tallest of them, ealled *Lot's Wife*, which rose 120 feet above low water mark, and in its shape resembling a needle, being undermined by the eonstant efforts of the waves, was thrown down, and totally disappeared. Needle || Negative.

NEEDS, or St NEOTS, six miles from Huntingdon, 58 miles from London, so called from the monument of a saint of that name in it, who was burnt by the Danes, is a large well built town, having a handsome strong church, with a very fine steeple, and a stone bridge over the Ouse. Its population in 1811 was 1988.

NEEDWOOD FOREST, in Staffordshire, between the Trent, Dove, and Blythe, and near Utoxeter, is said to exceed all the forests in England in the excellenee of its soil and the fineness of its turf.

NE EXEAT REGNO, in *Law*, is a writ to restrain a person from going out of the kingdom without the king's lieense. F. N. B. 85. It may be direeted to the sheriff, to make the party find surety that he will not depart the realm, and on refusal to commit him to prison: or it may be directed to the party himself; and if he then goes, he may be fined. And this writ is granted on a suit being commeneed against a man in the chancery, when the plaintiff fears the defendant will fly to some other country; and thereby avoid the justice and equity of the court; which hath been sometimes praetised: and when thus granted, the party must give bonds to the master of the rolls, in the penalty of 1000l. or some other large sum, for yielding obedienee to it; or satisfy the court, by answer, affidavit, or otherwise, that he hath no design of leaving the kingdom, and give security.

NEFASTI DIES, in Roman antiquity, an appellation given to those days wherein it was not allowed to administer justiee, or hold courts. They were so called because *non fari licebat*, the prætor was not allowed to pronounee the three solemn words or formulas of the law, *do*, *dico*, *addico*, I give, I appoint, I adjudge. These days were distinguished in the ealendar by the letter N. for *nefastus*; or N. P. *Nefastus Primo*, when the day was only *nefastus* in the forenoon, or first part. The days of a mixed kind were called *intercisi*.

NEGAPATAN, a town of Asia, in the peninsula on this side the Ganges, and on the coast of Coromandel. It was first a colony of the Portuguese, but was taken from them by the Duteh, and now forms part of the British territory. It is situated in E. Long. 79. 10. N. Lat. 11. 15.

NEGATION, in *Logic*, an aet of the mind affirming one thing to be different from another; as that the soul is not matter. See LOGIC.

NEGATIVE, in general, something that implies a negation: thus we say, negative quantities, negative powers, negative signs, &c.

NEGATIVE Sign. The use of the negative sign, in algebra, is attended with several consequenees that at first sight are admitted with difficulty, and has sometimes given occasion to notions that seem to have no real foundation. This sign implies, that the real value of the quantity represented by the letter to which it is prefixed is to be subtraeted; and it serves, with the positive sign, to keep in view what elements or parts enter into the composition of quantities, and in what

Negative Signs.

what manner, whether as increments or decrements, (that is, whether by addition or subtraction), which is of the greatest use in this art.

In consequence of this, it serves to express a quantity of an opposite quality to the positive, as a line in a contrary position; a motion with an opposite direction; or a centrifugal force in opposition to gravity; and thus often saves the trouble of distinguishing and demonstrating separately, the various cases of proportions, and preserves their analogy in view. But as the proportions of lines depend on their magnitude only, without regard to their position, and motions and forces are said to be equal or unequal, in any given ratio, without regard to their directions; and, in general, the proportion of quantity relates to their magnitude only, without determining whether they are to be considered as increments or decrements; so there is no ground to imagine any other proportion of $-b$ and $+a$ (or of -1 and 1) than that of the real magnitude of the quantities represented by b and a, whether these quantities are, in any particular case, to be added or subtracted. It is the same thing to subtract the decrement, as to add an equal increment, or to subtract $-b$ from $a-b$, as to add $+b$ to it: and because multiplying a quantity by a negative number implies only a repeated subtraction of it, the multiplying $-b$ by $-n$, is subtracting $-b$ as often as there are units in n; and is therefore equivalent to adding $+b$ so many times, or the same as adding $+n\,b$. But if we infer from this, that 1 is to $-n$ as $-b$ to $n\,b$, according to the rule, that unit is to one of the factors as the other factor is to the product, there is no ground to imagine, that there is any mystery in this, or any other meaning than that the real magnitudes represented by 1, n, b, and $n\,b$ are proportional. For that rule relates only to the magnitude of the factors and product, without determining whether any factor, or the product, is to be added or subtracted. But this likewise must be determined in algebraic computations; and this is the proper use of the rules concerning the signs, without which the operation could not proceed. Because a quantity to be subtracted is never produced in composition by any repeated addition of a positive, or repeated subtraction of a negative, a negative square number is never produced by composition from the root. Hence $\sqrt{-1}$, or the square root of a negative, implies an imaginary quantity; and in resolution, is a mark or character of the impossible cases of a problem, unless it is compensated by another imaginary symbol or supposition, when the whole expression may have a real signification. Thus $1+\sqrt{-1}$, and $1-\sqrt{-1}$, taken separately, are imaginary, but their sum is 2; as the conditions that separately would render the solution of a problem impossible, in some cases destroy each others effect when conjoined. In the pursuit of general conclusions, and of simple forms representing them, expressions of this kind must sometimes arise where the imaginary symbol is compensated in a manner that is not always so obvious.

By proper substitutions, however, the expression may be transformed into another, wherein each particular term may have a real signification as well as the whole expression. The theorems that are sometimes briefly discovered by the use of this symbol, may be demonstrated without it by the inverse operation, or some other way; and though such symbols are of some use in the computations by the method of fluxions, its evidence cannot be said to depend upon arts of this kind. See ALGEBRA and FLUXIONS.

Negative Signs || Negro.

NEGATIVE Electricity. See the article ELECTRICITY, *passim*. See also *POSITIVE Electricity*.

NEGINOTH. This term is read before some of the Psalms, as Psalm lxvii. It signifies *string instruments of music*, to be played on by the fingers, or women musicians; and the titles of these Psalms where this word is found, may be thus translated, *A psalm of David to the master of music, who presides over the string instruments.*

NEGOMBO, a sea port town of Asia, on the west coast of Ceylon. It has a fort built by the Portuguese, which was taken from them by the Dutch in 1640. E. Long. 80. 25. N. Lat. 17. 0.

NEGRIL POINT, the most westerly promontory of the island of Jamaica.

NEGRO, *Homo pelli nigra*, a name given to a variety of the human species, who are entirely black, and are found in the torrid zone, especially in that part of Africa which lies within the tropics. In the complexion of Negroes, we meet with many various shades; but they likewise differ far from other men in all the features of their face. Round cheeks, high cheek-bones, a forehead somewhat elevated, a short, broad, flat nose, thick lips, small ears, ugliness, and irregularity of shape, characterize their external appearance. The negro women have the loins greatly depressed, and very large buttocks, which gives the back the shape of a saddle. Vices the most notorious seem to be the portion of this unhappy race; idleness, treachery, revenge, cruelty, impudence, stealing, lying, profanity, debauchery, nastiness, and intemperance, are said to have extinguished the principles of natural law, and to have silenced the reproofs of conscience. They are strangers to every sentiment of compassion, and are an awful example of the corruption of man when left to himself.

The origin of the negroes, and the cause of their remarkable difference from the rest of the human species, has much perplexed the naturalists. Mr Boyle has observed, that it cannot be produced by the heat of the climate: for though the heat of the sun may darken the colour of the skin, yet experience does not show that it is sufficient to produce a new blackness like that of the negroes.

In Africa itself, many nations of Ethiopia are not black; nor were there any blacks originally in the West Indies. In many parts of Asia under the same parallel with the African region inhabited by the blacks, the people are but tawney. He adds, that there are negroes in Africa beyond the southern tropic; and that a river sometimes parts nations, one of which is black, and the other only tawney. Dr Barriere alleges that the gall of negroes is black, and being mixed with their blood is deposited between the skin and scarf-skin. However, Dr Mitchell of Virginia, in the Philosophical Transactions, N° 476, has endeavoured by many learned arguments to prove, that the influence of the sun in hot countries, and the manner of life of their inhabitants, are the remote causes of the colour of the negroes, Indians, &c. Lord Kames,

on

Negro. on the other hand, and such philosophers as he, whose genius and imagination are too lively to submit to a dry and painful investigation of facts, have contended that no physical cause is sufficient to change the colour, and what we call the regular features of white men, to the dark hue and deformity of the woolly-headed negro. Their arguments have been examined with much acuteness and ingenuity by Dr Stanhope Smith of New Jersey, Dr Hunter, and Professor Zimmerman, who have made it in a high degree probable, that the action of the sun is the original and chief cause of the black colour, as well as distorted features of the negro. See AMERICA, N° 48—51. and COMPLEXION.

True negroes are found in no quarter of the globe where the heat of the climate is not very great. They exist nowhere but in the torrid zone, and only in three regions situated in that zone, viz. in Senegal, in Guinea, and on the western shores of Africa, in Nubia, and the Papous land, or what is called *New Guinea*. In all these regions the atmosphere is scorching, and the heat excessive. The inhabitants of the north are whitest; and as we advance southwards towards the line, and those countries on which the sun's rays fall more perpendicularly, the complexion gradually assumes a darker shade. And the same men, whose colour has been rendered black by the powerful action of the sun, if they remove to the north, gradually become whiter (at least their posterity), and lose their burnt colour. Whites when transported into the burning regions of the torrid zone, are the first subject to fever; the skin of the face, hands, and feet, becomes burnt, hardens and falls off in scales. Hitherto the colour of negroes appears to be only local, extrinsic, and accidental, and their short frizzled and sparse hair is to be accounted for in the very same manner.

Climate possesses great and evident influences on the hair, not only of men, but of all other animals. If in one case these transmutations are acknowledged to be consistent with identity of kind, they ought not in the other to be esteemed criterions of different species. Nature has adapted the pliancy of her work to the situations in which she may require it to be placed. The beaver and sheep removed to the warm latitudes exchange, the one its fur, and the other its wool, for a coarse hair that preserves the animal in a more moderate temperature. The coarse and black shag of the bear is converted, in the arctic regions, into the finest and whitest fur. The colour of the hair is likewise changed by climate. The bear is white under the arctic circle; and, in high northern latitudes, foxes, hares, and rabbits, are found white. Similar effects of climate are discernible on mankind. The hair of the Danes is generally red; of the English, fair or brown; and of the French, commonly black. The hair of all people of colour is black, and that of the African negroes is likewise sparse and curled in a manner peculiar to themselves; but this peculiarity is analogous to the effect which a warm climate has on almost every other animal. Cold, by obstructing the perspiration, tends to throw out the perspirable matter accumulated at the skin in an additional coat of hair. A warm climate, by opening the pores, evaporates this matter before it can be concreted into the substance of hair; and the laxness and aperture of the pores render the hair liable to be easily eradicated by innumerable incidents. Its curl may result in part from the nature of the secretion by which it is nourished, and in part from external heat. That it depends in some degree on the quality of the secretion is rendered highly probable from its appearance on the chin and other parts of the human body. Climate is as much distinguished by the nature and proportion of the secretions as by the degree of heat. (See PHYSIOLOGY, sect. 6.). Whatever be the nutriment of the hair, it is evidently combined in the torrid zone of Africa with some fluid of a highly volatile or ardent quality, which produces the rank smell of many African nations. Saline secretions tend to curl and to burn the hair. The evaporation of any volatile spirit would render its surface dry and disposed to contract; whilst the centre continuing distended by the vital motion, these opposite dilatations and contractions would necessarily produce a curve, and make the hair grow involved. External and violent heat parching the extremities of the hair, tends likewise to involve it. A hair held near the fire instantly coils itself up. Africa is the hottest country on the globe; and the influence of its heat, either external or internal, or both, in giving the peculiar form to the hair of the natives, appears, not only from its sparseness and its curl, but from its colour. It is not of a shining, but of an adust black; and its extremities tend to brown, as if it had been scorched by the fire. Negro.

The peculiarities of the negro features and form may likewise be accounted for from the excessive heat of the climate and the state of African society. Being savages, they have no arts to protect them from the rays of a burning sun. The heat and serenity of the sky preserving the lives of the children without much care of the parents, they seem of course to be, in the interior parts of the country, negligent of their offspring. Able themselves to endure the extremes of that ardent climate, they inure their children to it from their most tender age. They suffer them to roll in the dust and sand beneath the direct rays of a vertical sun. The mother, if she be engaged, lays down the infant on the first spot she finds, and is seldom at the pains to seek the miserable shelter of a barren shrub, which is all that the interior country affords. When we reflect on the influence of a glare of light upon the eye, and on the contortions of countenance produced by our efforts to repel or prevent it, we need not wonder, that the pliant features of a negro infant should, by constant exposure, acquire that permanent irregularity which we term their characteristic ugliness. But besides the climate, food and clothing and modes of life have prodigious effects on the human form and features. This is apparent even in polished societies, where the poor and labouring part of the community are much more coarse in their features, and ill formed in their limbs, than persons of better fortune and more liberal means of subsistence. What an immense difference exists in Scotland, for instance, between the chiefs and the commonalty of the Highland clans? If they had been separately found in different countries, they would have been ranged by some philosophers under different species. A similar distinction takes place between the nobility and peasantry of France, of Spain, of Italy, and of Germany.

That food and clothing, and the different modes of life, have as great an influence upon the shapes and features of the Africans as upon the natives of Europe, is evident

Negro. evident from the different appearances of the negroes in the southern republics of America according to the stations in which they are employed. "The field slaves (says Dr Smith) are badly fed, clothed, and lodged. They live in small huts on the plantations, where they labour remote from the society and example of their superiors. Living by themselves, they retain many of the customs and manners of their African ancestors. The domestic servants, on the other hand, who are kept near the persons, or employed in the families of their masters, are treated with great lenity; their service is light; they are fed and clothed like their superiors; they see their manners, adopt their habits, and insensibly receive the same ideas of elegance and beauty. The field slaves are, in consequence, slow in changing the aspect and figure of Africa. The domestic servants have advanced far before them in acquiring the agreeable and regular features, and the expressive countenance of civil society. The former are frequently ill-shaped. They preserve, in a great degree, the African lips, nose, and hair. Their genius is dull, and their countenance sleepy and stupid. The latter are straight and well proportioned; their hair extended to three, four, and sometimes even to six or eight inches; the size and shape of the mouth handsome, their features regular, their capacity good, and their look animated."

Upon the whole, we hope that the reader, who shall candidly weigh in his own mind what we have said at present and under the article COMPLEXION, will agree with us, that the black colour in the torrid zone, the sparse crisp hairs of the negroes, and the peculiarities of their features and form, proceed from causes altogether extrinsic; that they depend on local temperature and the state of society; and that they are as accidental as the various shades of colour which characterise the different nations of Europe. If the whites be considered as the stock whence all others have sprung, it is easy to conceive how they have degenerated into negroes. Some have conjectured that the complete change may have taken place at the end of three centuries, whilst others have thought that it could not be effected in less than double that period. Such conjectures can be formed from no certain data; and a much greater length of time is undoubtedly necessary before negroes, when transplanted into our temperate countries, can entirely lose their black colour. By crossing the breed with whites, every taint of the negro colour may be expelled we believe, from the fifth generation (A).

But the most serious charge brought against the poor negroes is, that of the *vices* said to be natural to them. If they be, indeed, such as their enemies represent them, treacherous, cruel, revengeful, and intemperate, by a necessity of *nature*, they must be a different race from the whites; for though all these vices abound in Europe, it is evident that they proceed not from nature, but from wrong education, which gives to the youthful mind such deep impressions as no future exertions can completely eradicate. Let us inquire coolly if the vices of the negroes may not have a similar origin. Negro.

In every part of Africa with which the nations of Europe have any commerce, slavery prevails of the worst kind. Three-fourths of the people are slaves to the rest, and the children are born to no other inheritance. "Most parts of the coast differ in their governments; some are absolute monarchies, whilst others draw near to an aristocracy. In both the authority of the chief or chiefs is unlimited, extending to life, and it is exercised as often as criminal cases require, unless death is commuted into slavery; in which case the offender is sold, and if the shipping will not buy the criminal, he is immediately put to death. Fathers of free condition have power to sell their children, but this power is very seldom enforced. In Congo however, a father † will sell a son or daughter, or perhaps both, for a piece of cloth, a collar or girdle of coral or beads, and often for a bottle of wine or brandy. A husband may have as many wives as he pleases, and repudiate or even sell them, though with child, at his pleasure. The wives and concubines, though it be a capital crime for the former to break the conjugal faith, have a way to rid themselves of their husbands, if they have set their affections upon a new gallant, by accusing them of some crime for which the punishment is death. In a word, the bulk of the people in every state of Africa are born slaves to great men, reared as such, held as property, and as propety sold (see SLAVERY). There are indeed many circumstances by which a free man may become a slave: such as being in debt, and not able to pay; and in some of such cases, if the debt be large, not only the debtor, but his family likewise, become the slaves of his creditor, and may be sold. Adultery is commouly punished in the same manner, both the offending parties being sold, and the purchase-money paid to the injured husband. *Obi*, or pretended witchcraft (in which all the negroes firmly believe, see WITCHCRAFT), is another, and a very common offence, for which slavery is adjudged the lawful punishment; and it extends to all the family of the offender. There are various other crimes which subject the offender and his

Edwards's History of the West Indies, vol. ii.

† *Mod. Univer. History*, vol. xiii. P. 55.

Edwards's History of the West Indies.

(A) 1. A white man with a negro woman, or negro man with a white woman, produce a mulatto, half white and half black, or of a yellow-blackish colour, with black, short frizzled hair. 2. A white man with a mulatto woman, or a negro with a mulatto woman, produce a *quadroon*, three-fourths white and one-fourth black, or three-fourths black and one-fourth white, or of a lighter yellow than the former. In America, they give the name of *cabres* to those who are descended from a black man and a mulatto woman, or a mulatto man and a black woman, who are three-fourths black and one-fourth white, and who are not so black as a negro, but blacker than a mulatto. 3. A white man with a quadroon woman, or a negro with a quadroon woman, produce a *mestizo*, seven-eighths white and one-eighth black, or seven-eighths black and one-eighth white. 4. A white man with a mestizo woman, or a negro with a mestizo woman, produce, the one almost a perfect white, the other almost a perfect black, called a *quinteroon*. This is the last gradation, there being no visible difference between the fair quinteroons and the whites: and the children of a white and quinteroon consider themselves as free from all taint of the negro race.

Negro

his children to be sold; and it is more than probable, that if there were no buyers, the poor wretches would be murdered without mercy.

In such a state of society, what dispositions can be looked for in the people, but cruelty, treachery, and revenge? Even in the civilized nations of Europe, blessed with the lights of law, science, and religion, some of the lower orders of the community consider it as a very trivial crime to defraud their superiors; whilst almost all look up to them with stupid malevolence or rancorous envy. That a depressed people, when they get power into their hands, are revengeful and cruel, the present age affords a dreadful proof in the conduct of the demagogues of a neighbouring nation; and is it wonderful that the negroes of Africa, unacquainted with moral principles, blinded by the cruellest and most absurd superstitions, and whose customs tend to eradicate from the mind all natural affection, should sometimes display to their lordly masters of European extraction the same spirit that has been so generally displayed by the lower orders of Frenchmen to their ecclesiastics, their nobles, and the family of their murdered sovereign! When we consider that the majority of the negroes groan under the cruellest slavery, both in their own country, and in every other where they are to be found in considerable numbers, it can excite no surprise that they are in general treacherous, cruel, and vindictive. Such are the caprices of their tyrants at home, that they could not preserve their own lives or the lives of their families for any length of time, but by a perpetual vigilance, which must necessarily degenerate, first into cunning, and afterwards into treachery; and it is not conceivable that habits formed in Africa should be instantly thrown off in the West Indies, where they are the property of men whom some of them must consider as a different race of beings.

But the truth is, that the ill qualities of the negroes have been greatly exaggerated. Mr Edwards, in his valuable History of the West Indies, assures us that the Mandingo negroes display such gentleness of disposition and demeanor, as would seem the result of early education and discipline, were it not that, generally speaking, they are more prone to theft than any of the African tribes. It has been supposed that this propensity, among other vices, is natural to a state of slavery, which degrades and corrupts the human mind in a deplorable manner; but why the Mandingoes should have become more vicious in this respect than the rest of the natives of Africa in the same condition of life, is a question he cannot answer.

"The circumstances which (according to the same author) distinguish the Koromantyn or Gold Coast negroes from all others, are firmness both of body and mind; a ferociousness of disposition; but withal, activity, courage, and a stubbornness, or what an ancient Roman would have deemed an elevation of soul, which prompts them to enterprises of difficulty and danger, and enables them to meet death, in its most horrid shape, with fortitude or indifference. They sometimes take to labour with great promptitude and alacrity, and have constitutions well adapted for it; for many of them have undoubtedly been slaves in Africa. But as the Gold Coast is inhabited by various tribes, which are engaged in perpetual warfare and hostility with each other, there cannot be a doubt that many of the captives taken in battle, and sold in the European settlements, were of free condition in their native country, and perhaps the owners of slaves themselves. It is not wonderful that such men should endeavour, even by means the most desperate, to regain the freedom of which they have been deprived; nor do I conceive that any further circumstances are necessary to prompt them to action, than that of being sold into captivity in a distant country. One cannot surely but lament (says our author) that a people thus naturally intrepid, should be sunk into so deplorable a state of barbarity and superstition; and that their spirits should ever be broken down by the yoke of slavery. Whatever may be alleged concerning their ferociousness and implacability in their present notions of right and wrong, I am persuaded that they possess qualities which are capable of, and well deserve, cultivation and improvement.

Negro

"Very different from the Koromantyns are the negroes imported from the Bight of Benin, and known in the West Indies by the name of Eboes. So great is their constitutional timidity and despondency of mind, as to occasion them very frequently to seek, in a voluntary death, a refuge from their own melancholy reflections. They require therefore the gentlest and mildest treatment to reconcile them to their situation; but if their confidence be once obtained, they manifest as great fidelity, affection, and gratitude, as can reasonably be expected from men in a state of slavery. The females of this nation are better labourers than the men, probably from having been more hardly treated in Africa.

"The natives of Whidah, who, in the West Indies, are generally called *Papaws*, are unquestionably the most docile and best disposed slaves that are imported from any part of Africa. Without the fierce and savage manners of the Koromantyn negroes, they are also happily exempt from the timid and desponding temper of the Eboes. The cheerful acquiescence with which these people apply to the labours of the field, and their constitutional aptitude for such employment, arise, without doubt, from the great attention paid to agriculture in their native country. Bosman speaks with rapture of the improved state of the soil, the number of villages, and the industry, riches, and obliging manners of the natives. He observes, however, that they are much greater thieves than those of the Gold Coast, and very unlike them in another respect, namely, in the dread of pain, and the apprehension of death. They are, says he, so very apprehensive of death, that they are unwilling to hear it mentioned, for fear *that* alone should hasten their end; and no man dares to speak of death in the presence of the king, or any great man, under the penalty of suffering it himself, as a punishment for his presumption. He relates further, that they are addicted to gaming beyond any people of Africa. All these propensities are observable in the character of the Papaws in a state of slavery in the West Indies. That punishment which excites the Koromantyn to rebel, and drives the Ebo negro to suicide, is received by the Papaws as the chastisement of legal authority, to which it is their duty to submit patiently. The case seems to be, that the generality of these people are in a state of absolute slavery in Africa, and, having been habituated to a life of labour, they submit to a change of situation with little reluctance."

Negro. Having recited such observations as occurred to him on contemplating the various tribes of negroes from each other, Mr Edwards thus estimates their general character, influenced as they are by circumstances which soon efface the native and original impressions which distinguish one nation from another when newly imported into the West Indies.

"Notwithstanding what has been related of the firmness and courage of the natives of the Gold Coast, it is certain that the negroes in general in our islands (such of them at least as have been any length of time in a state of servitude) are of a distrustful and cowardly disposition. So degrading is the nature of slavery, that fortitude of mind is lost as free agency is restrained. To the same cause probably must be imputed their propensity to conceal or violate the truth; which is so general, that the vice of falsehood is one of the most prominent features in their character. If a negro is asked even an indifferent question by his master, he seldom gives an immediate reply; but, affecting not to understand what is said, compels a repetition of the question, that he may have time to consider, not what is the true answer, but what is the most politic one for him to give. The proneness observable in many of them to the vice of theft has already been noticed; and I am afraid (says our author), that evil communication makes it almost general. It is no easy matter, I confess, to discriminate those circumstances which are the result of proximate causes, from those which are the effects of national customs and early habits in savage life; but I am afraid that cowardice and dissimulation have been the properties of slavery in all ages, and will continue to be so to the end of the world. It is a situation that necessarily suppresses many of the best affections of the human heart.—If it calls forth any latent virtues, they are those of sympathy and compassion towards persons in the same condition of life; and accordingly we find that the negroes in general are strongly attached to their countrymen, but above all, to such of their companions as came in the same ship with them from Africa. This is a striking circumstance: the term *shipmate* is understood among them as signifying a relationship of the most endearing nature; perhaps as recalling the time when the sufferers were cut off together from their common country and kindred, and awakening reciprocal sympathy from the remembrance of mutual affliction. But their benevolence, with a very few exceptions, extends no further. The softer virtues are seldom found in the bosom of the enslaved African. Give him sufficient authority, and he becomes the most remorseless of tyrants. Of all the degrees of wretchedness endured by the sons of men, the greatest, assuredly, is the misery which is felt by those who are unhappily doomed to be the slaves of slaves; a most unnatural relation, which sometimes takes place in the sugar plantations. The same observation may be made concerning their conduct towards the animal creation. Their treatment of cattle under their direction is brutal beyond belief. Even the useful and social qualities of the dog secure to him no kind usage from an African master. One of the most pleasing traits in their character is the respect and attention which they pay to their aged countrymen. The whole body of negroes on a plantation must be reduced to a deplorable state of wretchedness, if at any time, they suffer their aged companions to want the common necessaries of life, or even many of its comforts, as far as they can procure them. They seem to be actuated on these occasions by a kind of involuntary impulse, operating as a primitive law of nature, which scorns to wait the cold dictates of reason: among them, it is the exercise of a common duty, which courts no observation, and looks for no applause."

Negro, Negroland.

As the colour and features, and moral qualities of the negroes, may be thus easily accounted for by the influence of climate and the modes of savage life, so there is good reason to believe that their intellectual endowments are equal to those of the whites who have been found in the same circumstances. Of those imitative arts in which perfection can be attained only in an improved state of society, it is natural to suppose that they have but little knowledge; but the fabric and colours of the Guinea cloths are a proof of their native ingenuity. In the West Indies many of them are expert carpenters, some watchmakers, and one or two have successfully practised physic; while others have figured both in Latin and English poetry, so that we cannot doubt but that "God, who made the world, hath made of one blood all nations of men," and animated them with minds equally rational.

NEGROLAND, or NIGRITIA, a country of Africa, lying next to Guinea towards the north, and extending from 18° of west to 23° of east longitude, and from 9° to 20° of north latitude. On the north it is bounded by Zaara or the Desert; on the east, by countries unknown; on the south, by Guinea; and on the west, by the Atlantic ocean; and is watered by the great river Niger or Senegal, which runs through it from east to west. The Europeans have settlements on the coasts of this country, especially near the mouths of the Niger and Gambia, which last is supposed to be a branch of the former. A great many nations inhabit the banks of the rivers; some Pagans, some Mohammedans, of different languages, and independent of one another. The country is fruitful, especially along the rivers; abounding in rice, Guinea grain, and Indian corn, where it is cultivated; and with cocoa nuts, plantains, pulse, palm trees, and tropical fruits; nor is it destitute of cattle, and a variety of other animals, particularly such as abound in Guinea. See GUINEA.

Negroland is fertilized by the overflowing of its rivers the Senegal and Gambia, as Egypt is by the Nile. It hath not yet been ascertained whether the Gambia is a branch of the Senegal or not. As far as the Europeans have penetrated up the country, they appear to be distinct; and the Mandingo negroes report that the Gambia has a different origin. The entrance into Senegal river, is narrow and somewhat difficult, by reason of its immoveable bar, and sandy shoals, as well as the several islands at the mouth of it, and the several canals and marshes that clog it: but after sailing up eight or ten leagues, it is found broad and deep, and fit to carry large vessels; and, excepting about five or six leagues on each side above the mouth, which is sandy and barren ground, the banks are covered with stately trees and villages, and the country in general is fertile and well watered; for, like the Nile, this river overflows its banks for many leagues, and enriches the land to a great degree,

Negroland || Negropont.

gree, though, for want of skill, the inhabitants do not reap the advantages which they might obtain from its fertility. The people on both sides of the river live as near to it as they can, and feed great herds of cattle, sowing large and small millet, the former of which is called by us *Turkey wheat*, in great quantities, and with great increase. If the river fails of overflowing at its usual season, a great scarcity ensues in the adjacent country; and, even when it overflows regularly, it breeds such vast flights of grashoppers and insects, as quite darken the air, and frequently devour the whole produce of the soil: in which case the people kill those insects and eat them; which they do either by pounding in leather bags, and then boiling them in milk, or which is reckoned the more delicious method, by frying or broiling them over a light blaze in a fryingpan full of holes. Thus the legs and wings of the insects are burnt off, and the rest of the body is sufficiently roasted to be eaten as a dainty, which they look upon to be very wholesome and nourishing.

To the east, north-east, and south-east of the island of Senegal, the country, as far as it is known, is overrun with woods and marshes: the Senegal, Gambia, and Sherbro, passing through it in their way to the Atlantic ocean. The Niger rises near the Senegal, and runs eastward, but its termination is unknown. During the rainy months, which begin in July, and continue to October, they lay the whole country under water; and indeed the sudden rise of these rivers is incredible to such as are not acquainted with the violent rains that fall between the tropics. At Galam, 900 miles from the mouth of the Senegal, the waters rise 150 feet perpendicular from the bed of the river. At the island of Senegal, the river rises gradually, during the rainy season, above 20 feet perpendicular over part of that flat coast; which of itself, so freshens the water that ships lying at anchor, at the distance of three leagues from its mouth, generally make use of it, and fill their water there for their voyage home. When the rains are at an end, which soon happens in October, the intense heat of the sun usually dries up those stagnating waters which lie on the higher parts, and the remainder from lakes and marshes, in which are found all sorts of dead animals. At last, those too are quite dried up; and then the effluvia that arise are almost quite insupportable. At this season the winds blow so hot from the land, that they may be compared to the heat proceeding from the mouth of an oven, and they bring with them an intolerable smell. The wolves, tigers, lions, and other wild beasts, then resort to the river, steeping their body under water, and only their snout above it for the sake of breathing. The birds soar to an immense height in the air, and fly a vast way over the sea, where they continue till the wind changes, and comes from the west.

Negroes, White. See Heliophobi and Albino.

NEGROMANCY. See Necromancy.

NEGROPONT, anciently *Eubœa*, an island of the Archipelago, stretching along the eastern coast of Achaia or Livadia, from which it is separated by a narrow channel called the *Euripus*. This strait is so narrow, that the island is joined to the continent by a bridge thrown over it; and here, it is thought, there was formerly an isthmus. The irregularity of the tides in the Euripus hath from the remotest antiquity been very remarkable, and this irregularity is found to be connected with the age of the moon. From the three last days of the old moon to the eighth day of the new moon, and from the 14th to the 20th day inclusive, they are regular, but on the other days they are irregular, flowing 12, 13, or 14 times in the space of 24 hours, and ebbing as often. The island is 90 miles long and 25 broad in the widest part; and produces corn, oil, fruit, and cattle, in great abundance. The only place in the island worth notice is the capital, which is also called *Negropont*; and which is walled, and contains about 15,000 inhabitants; but the Christians are said to be much more numerous than the Turks. The captain bashaw, or admiral of Turkey, who is also governor of the city, the island, and the adjacent continent of Greece, resides here: and the harbour, which is very safe and spacious, is seldom without a fleet of galleys, ready to be put to sea against the pirates and the Maltese. A part of the bridge between the city and the coast of Greece, consists of a draw bridge no longer than just to let a galley pass through.

Negropont. Nehemiah.

NEHEMIAH, or Neemias, son of Hachaliah, was born at Babylon during the captivity, (Neh. i. 1, 2, &c.). He was, according to some, of the race of the priests, but according to others, of the tribe of Judah and the royal family. Those who maintain the first opinion, support it by a passage in Ezra, (x. 10.) where he is called a priest; but those who believe that he was of the race of the kings of Judah, say, 1st, That Nehemiah having governed the republic of the Jews for a considerable time, there is great probability he was of that tribe of which the kings always were. 2dly, Nehemiah mentions his brethren Hanani, and some other Jews, who coming to Babylon during the captivity, acquainted him with the sad condition of their country. 3dly, The office of cupbearer to the king of Persia, to which Nehemiah was promoted, is a further proof that he was of an illustrious family. 4thly, He excuses himself from entering into the inner part of the temple, probably because he was only a laic, (Neh. vi. 11.) "Should such a man as I flee? And who is there that, being as I am, would go into the temple to save his life?"

The Scripture (Ezra ii. 63. Nehem. vii. 65.) calls him הדשתא *tirshatha*, that is to say, "cup-bearer;" for he had this employment at the court of Artaxerxes Longimanus. He had an exceeding great tenderness for the country of his fathers, though he had never seen it; and one day, as some Jews newly come from Jerusalem acquainted him with the miserable estate of that city, that its wall were beat down, its gates burnt, and the Jews were become a reproach among all nations; he was sensibly affected with this relation; he fasted, prayed, and humbled himself before the Lord, that he would be favourable to the design he had then conceived of asking the king's permission to rebuild Jerusalem. The course of his attendance at court being come, he presented the cup to the king according to custom; but with a countenance sad and dejected; which the king observing, entertained some suspicion, as if he might have had some bad design; but Nehemiah (ii.) discovering the occasion of his disquiet, Artaxerxes gave him leave to go to Jerusalem, and repair its walls and gates; but, however, upon this condition, that he

Nehemiah. should return to court at a time appointed. Letters were made out, directed to the governors beyond the Euphrates, with orders to furnish Nehemiah with timbers necessary for covering the towers and gates of the city, and the house designed for Nehemiah himself, who was now appointed governor of Judea, in the year of the world 3350.

Nehemiah being arrived at Jerusalem with the king's commission, went round the city; and having viewed the condition of the walls, assembled the chief of the people, produced his commission, and exhorted them to undertake the reparation of the gates and walls of the city. He found every person ready to obey him; whereupon he immediately began the work. The enemies of the Jews observing these works in such forwardness, made use of all the means in their power to deter Nehemiah from this undertaking, and made several attempts to surprise him; but finding that their designs were discovered, and that the Jews kept upon their guard, they had recourse to craft and stratagem, endeavouring to draw him into an ambuscade in the fields, where they pretended they would finish the dispute at an amicable conference: but Nehemiah gave them to understand, that the work he had begun required his personal attendance; and therefore he could not come to them. He sent the same answer to four several messages that they sent one after another on the same subject, (*Id.* iv. and vi.).

Sanballat, the chief of the enemies of the Jews, together with his associates, wrote word, that a report was spread that the Jews were building the walls of Jerusalem only with a design to make it a place of strength, to support them in an intended revolt; that it was said also that Nehemiah had suborned false prophets to favour his designs, and to encourage the people to choose him king; and to stop the course of these rumours, he advised him to come to him, that they might confer together, and take such resolutions as should be found convenient. Nehemiah gave himself no trouble on this account, but returned for answer, that all those accusations were false and made at random. About the same time he discovered, that a false prophet called *Shemaiah*, had been corrupted by his enemies, and that some of the chief of the city were secretly in confederacy with them. Yet all this did not discourage him; he went on with his work, and happily completed it in two and fifty days after it had been begun.

Then he made a dedication of the walls, of the towers, and of the gates of Jerusalem, with the solemnity and magnificence that such a work required. He separated the priests, the Levites, and the princes of the people, into two companies, one of which walked to the south and the other to the north, on the top of the walls. These two companies were to meet at the temple. The procession was accompanied with music both vocal and instrumental: and when they were all come to the temple, they there read the law, offered sacrifices, and made great rejoicings. And as the feast of tabernacles happened at the same time, it was celebrated with great solemnity, (*Id.* viii.). Nehemiah observing that the compass of the city was too large for its inhabitants, he ordered that the chief of the nation should fix their dwelling in the city; and caused them to draw lots, by which a tenth part of the whole people of Judah were to dwell at Jerusalem, (*Id.* xi.). Then he applied himself to the reformation of such abuses as had crept into the administration of the public affairs. He curbed the inhumanity of the great ones, who held in a state of slavery the sons and daughters of those who were poor or unfortunate, keeping their lands in possession, which these poor people had been obliged either to mortgage or to sell to the rich. Another abuse there was, which Ezra had in vain attempted to redress, that they had contracted marriages with strange and idolatrous women. Nehemiah undertook to dissolve these marriages, succeeded in it, and sent away all such women as had been taken against the express command of the law, (*Id.* ix.). Having likewise observed, that the priests and Levites were obliged to take refuge wherever they could, and so the ministry of the temple was not attended or performed with that decency it ought, because they did not receive the revenues that the law had appointed for their subsistence; he obliged the people punctually to pay the ministers of the Lord what was due to them, and enjoined the priests and Levites duly to attend on their respective duties, and to discharge their functions, (*Id.* xiii. 10, 11, &c.). He enforced the observation of the sabbath, which had been much neglected at Jerusalem, and would not permit strangers to come in to buy and sell, but kept the gates of the city shut all that day. And, to perpetuate as much as was possible these good regulations which he had newly established, he engaged the chief men of the nation solemnly to renew the covenant with the Lord. This ceremony was performed in the temple, and an instrument was drawn up, which was signed by the principal men, both priests and people (*Id.* ix. x.), in the year of the world 3551. Nehemiah.

We read in the books of Maccabees (2 Macc. i. 19, 20, 21. &c.), that Nehemiah sent to search for the holy fire, which before the captivity of Babylon the priests had hid in a dry and deep pit; but not finding any fire there, but instead thereof a thick and muddy water, he sprinkled this upon the altar; whereupon the wood which had been sprinkled with this water took fire presently as soon as the sun began to appear. Which miracle coming to the knowledge of the king of Persia, he caused the place to be encompassed with walls where the fire had been hid, and granted great favours and privileges to the priests. It is recorded in the same books, (2 Macc. ii. 13, 14.), that Nehemiah erected a library, wherein he placed whatever he could find, either of the books of the prophets, of David, or of such princes as had made presents to the temple. Lastly, he returned to Babylon (*Id.* v. 14. and xiii. 6.) according to the promise he had made to King Artaxerxes, about the thirty-second year of this prince, in the year 3563. From thence he returned again to Jerusalem, where he died in peace, about the year 3580, having governed the people of Judah for about thirty years.

The book which in the English Bible, as also in the Hebrew, has the name of *Nehemiah*, in the Latin Bible is called the book of *Esdras;* and it must be confessed, that though this author speaks in the first person, and though at first reading one would think that he had writ it day by day as the transactions occurred, yet there are some things in this book which could not have been written by Nehemiah himself; for example, memorials are quoted wherein were registered the names of

Nehemiah || Nelson.

of the priests in the time of Jonathan the son of Eliashib, and even to the times of the high priest Jaddus, who met Alexander the Great. These therefore must have been added afterwards.

It may well be questioned, whether this Nehemiah be the same that is mentioned in Ezra, (ii. 2. and Neh. vii. 7.) as one that returned from the Babylonish captivity under Zerubbabel; since from the first year of Cyrus to the twentieth of Artaxerxes Longimanus, there are no less than ninety-two years intervening; so that Nehemiah must at this time have been a very old man, upon the lowest computation an hundred, consequently utterly incapable of being the king's cup-bearer, of taking a journey from Shushan to Jerusalem, and of behaving there with all the courage and activity that is recorded of him. Upon this presumption, therefore, we may conclude that this was a different person, though of the same name, and that Tirshatha (the other name by which he is called, Ezra ii. 63. and Neh. vii. 65.) denotes the title of his office, and both in the Persian and Chaldean tongues was the general name given to the king's deputies and governors.

NEHOW, one of the Sandwich islands, discovered by Captain Cook in his last voyage to the Pacific ocean: these islands are eleven in number, and are situated from 18° 44′ to 22° 15′ N. Lat. and from 154° 56′ to 160° 24′ W. Long.

NEIGHBOUR, 1. One who dwells or is seated near to another (2 Kings iv. 3.). 2. Every man to whom we have an opportunity of doing good (Matt. xxii. 39.). 3. A fellow labourer of one and the same people (Acts vii. 27.). 4. A friend (Job. xvi. 21.). At the time of our Saviour, the Pharisees had restrained the word neighbour to signify those of their own nation only, or their own friends; being of opinion that to hate their enemy was not forbidden by their law. But our Saviour informed them, that the whole world were their neighbours; that they ought not to do to another what they would not have done to themselves; and that this charity ought to be extended even to their enemies, (Matt. v. 43. Luke x. 29, &c.).

NEISSE, a town of Silesia, containing 7000 people, and the residence of the bishop of Breslaw, who has a magnificent palace here. The air is very wholesome, and provisions are cheap; the inhabitants carry on a great trade in wine and linen. This place suffered greatly by an inundation and fire in 1729. It was taken by the Prussians in 1741, who augmented the fortifications, and built a citadel to which they gave the name of *Prussia*. It is seated on a river of the same name, in E. Long. 17. 35. N. Lat. 50. 32.

NEIUS MONS, in *Ancient Geography*, at the foot of which stood Ithaca, a town of the island of that name, (Homer).

NELSON, The Right Honourable VISCOUNT, one of the most celebrated naval commanders, was the son of the reverend Edmund Nelson, and was born at Burnham Thorpe, in Norfolk, where his father was rector, in the year 1758. He received his education at the school of North Walsham; but we are unacquainted with the particulars relative to his childhood, and whether the progress he made in his studies was in any respect extraordinary. It is certain, however, that he discovered a strong predilection for the naval profession at a very early period, and having quitted school at the age of twelve years, went on board the Raisonable of 64 guns, commanded by his mother's brother, Captain Maurice Suckling. Nelson.

In the month of April 1773, a voyage of discovery to the north pole was undertaken by the honourable Constantine John Phipps, afterwards Lord Mulgrave, in consequence of an application by the Royal Society to Lord Sandwich; and although the instructions which were issued, prohibited all boys from being received on board, yet the enterprising spirit of Horatio Nelson earnestly solicited to be appointed cockswain to Captain Lutwidge, rather than submit to be left behind; and his unsubdued spirit so forcibly struck the captain, that his wish was complied with.

When the ship returned to England in the month of October 1773, Mr Nelson having received information that a squadron was fitting out for the East Indies, employed all his interest to be appointed to one of the ships. It was not long before he was placed in the Seahorse of 20 guns, commanded by the celebrated Captain Farmer, and stationed in the fore-top to keep watch, but soon after removed to the quarter-deck.

He obtained the professional order of lieutenant on the 8th of April, 1777, and received his commission the next day, as second of the Lowestoffe of 32 guns, Captain William Locker, in which ship he arrived at Jamaica; but feeling that his glowing mind was circumscribed in so small a frigate, he requested the command of a schooner, which acted as tender to the Lowestoffe, thus availing himself of the opportunity of becoming an experienced pilot for every intricate passage through the islands, situated on the northern side of Hispaniola.

When Sir Peter Parker arrived at Jamaica in the year 1778, Lieutenant Nelson was nominated by that gallant admiral to be the third of his own flag ship, the Bristol, and by rotation soon became the first. In this ship his services terminated in the rank of a lieutenant.

On the 11th of June, 1779, he obtained the rank of post-captain; and during the nine years he had been in the service he not only became an able officer by his constant attention to every part of his duty, and his keen observation, but he also laid the foundation of being a pilot of distinguished eminence. The first ship to which he was appointed after being made a post captain, was the Hinchinbroke. On the arrival of Count d'Estaign at Hispaniola, as an attack upon Jamaica was immediately apprehended, Captain Nelson was intrusted with the command of the batteries of Port-Royal, with the concurring approbation of the British admiral and general. In the month of January 1780, it was resolved on to reduce Fort Juan, on the river St John, in the gulf of Mexico, when Captain Nelson was made choice of to command the naval department, and that of the military was committed to Major Polson. In accomplishing the object of this arduous and interesting undertaking, Nelson's usual intrepidity was again exhibited. Having quitted the ship under his command, he superintended the transporting of the troops in boats, 300 miles up a river, which none but Spaniards had ever navigated since the time of the buccaneers.

His great and vigorous exertions were represented by Major Polson to General Dalling in their true colours,

nor

Nelson. nor was his gallantry passed over by that officer in silence. After storming an out-work belonging to the enemy, he constructed batteries, and fought the Spaniards; and it is to his conduct in the reduction of Fort Juan that the success of Britain has been justly and chiefly ascribed. He was next appointed to the Janus, at that time stationed at Jamaica; on his arrival at which place every medical assistance was given him which his situation required; but as his health still continued on the decline, he deemed it expedient to return to England in his majesty's ship Lion, the honourable William Cornwallis commander, to whose unremitting care and attention he owed the preservation of his life. He obtained the command of the Albemarle in the month of August 1781, which put his delicate constitution to the severest trial, as he was stationed during the whole of the ensuing winter in the north seas.

He sailed from Quebec in the month of October, 1782, with a convoy to New York, where he had an opportunity of joining the fleet under Sir Samuel Hood; and in the month following he sailed with him to the West Indies, where he was honourably employed until the termination of hostilities. He soon after received orders to repair to England, being directed to attend in his way, his royal highness Prince William Henry on his visit to the Havannah. When he reached England, the Albemarle was paid off at Portsmouth on the 31st July, 1783. During the autumn of that year he paid a visit to France, where he continued till the spring of the ensuing year, when he received the command of the Boreas frigate of 28 guns, and his destination was the Leeward Islands, where he continued until June 1787, and was then ordered to repair to England. In the month of March the same year he was married to the amiable and accomplished widow of Dr Nesbit, of the island of Nevis. When the Boreas frigate was paid off at Sheerness on the 30th November, 1787, he retired to the parsonage-house of Burnham Thorpe, which had been conferred upon him by his father for a place of residence, there to enjoy the consolations which result from domestic felicity.

He again came forward on the 30th of January 1793, to shine forth more conspicuous as a naval officer than he had ever done before, at which time he received the command of the Agamemnon of 64 guns, being soon placed under the orders of that truly great and illustrious character, Lord Hood, who at that period was destined to command in the Mediterranean. The unlimited confidence reposed in him by this noble and gallant admiral, is an incontestable evidence of the high estimation in which his courage and naval abilities were held. If his superior designed to attack batteries, or cut ships out of the harbours in which they were moored; if troops were to be landed in perilous situations, or passages of extreme difficulty to be explored, the great Nelson took the lead on every such occasion, seconded by the brave officers and crew belonging to the Agamemnon. Toulon, Bastia, and Calvi, witnessed his gallant and intrepid deportment, of which Lord Hood did not fail to make honourable mention. At the siege of Calvi Captain Nelson lost the sight of his right eye, a shot from the battery of the enemy having struck that of which he had the command, and driven some particles of sand against his face with irresistible impetuosity.

When Lord Hood left his station in the Mediterranean in the month of October, 1794, the command devolved on Admiral Hotham, who honoured our hero with an equal share of his confidence and esteem. On the 13th and 14th of March, and 13th of July 1795, he again rendered himself conspicuous in the actions which then took place with the French fleet; and soon after he was chosen by Admiral Hotham to co-operate with General De Vins, on the coast of Genoa, in which service he continued so long as Hotham retained the command, who was superseded by Sir John Jervis. This officer so much applauded the conduct of Captain Nelson, that he received the honour of wearing a pendant of distinction; and in the month of May he was removed from the Agamemnon to the Captain of 74 guns. On the 11th of August he had a captain appointed under him. Nelson.

From April to October 1795, Commodore Nelson was continually employed in the most active and arduous service, the blockade of Leghorn, the taking of Porto Ferrajo, with the island of Caprea, and finally in the evacuation of Bastia. In December 1796 he hoisted his broad pendant on board La Minerve frigate, and was dispatched with that ship, and La Blanche, to Porto Ferrajo, to bring the naval stores left there to Gibraltar, which the fleet was in much want of. While on this service in the night of the 17th December, he fell in with two Spanish frigates, one of which he immediately attacked, and ordered the Blanche to bear down to engage the other. About half past ten the commodore brought his ship to close action, which continued without interruption till half past one, when the Spanish frigate of 40 guns, 28 of which were 18 pounders, struck to La Minerve.

After various other active and important services during the three preceding months, Sir Horatio Nelson, in April 1797, hoisted his flag on board the Captain of 74 guns as rear-admiral of the blue, and in the end of May he shifted his flag from the Captain to the Theseus, when he was appointed to the command of the inner squadron at the blockade of Cadiz. While on this service he exhibited another remarkable proof of his undaunted personal courage. In the attack on the Spanish gun-boats in July, he was boarded in his barge, which had only the usual complement of 10 men, and the cockswain. The commander of the Spanish gun-boats, in a barge with 30 men and officers, made a desperate attack on the admiral and his brave companions. The conflict remained long doubtful, but after 18 of the Spaniards were killed, and almost the whole of the remainder wounded, the rear-admiral and his brave crew succeeded in carrying this superior force.

On the 15th of July the same year, Admiral Nelson was detached with a small squadron to attack the town of Santa Cruz in the island of Teneriffe. A thousand men, including marines, were landed in the course of a dark night, made themselves masters of the town, and retained possession of it for seven hours; but finding it impossible to storm the citadel, they prepared for their retreat, which the Spaniards allowed them to make unmolested, agreeable to the stipulations which had been entered into. In this unfortunate attack the brave Nelson lost his arm by a cannon shot.

But a more splendid scene of the life of our hero is now opening. On the 13th of April 1798 he was detached

Nelson. tached from Earl St Vincent's fleet, in pursuit of the French to the coast of Egypt, with 12 sail of the line and one 50 gun ship, while the enemy's fleet consisted of 13 sail of the line and four frigates, protected by the batteries on the shore, and several gun-boats. This memorable action commenced at sunset, and terminated gloriously for the honour of our hero and that of the British navy. Nine sail of the line fell into the hands of the conqueror, two were burnt, and two effected their escape. The brave Nelson was wounded in the action, believing himself to have been shot through the head; but after his wound was examined by the surgeon, it was happily found not to be mortal, a circumstance which diffused the most lively satisfaction through the whole fleet. To the honour of this great man it ought to be mentioned, that even under the conviction of approaching dissolution, he prepared for the interesting change with calmness and fortitude, desired his chaplain to recommend him to Lady Nelson, appointed the brave Hardy to the rank of post-captain and to the command of a ship, and took an affectionate leave of Captain Louis.

The French admiral's ship, L'Orient, was blown up during the action. From the mainmast of this ship Captain Hallowell ordered a coffin to be constructed, which was presented to Admiral Nelson, and gratefully accepted by the hero, as a token of affectionate regard. For some months he had it placed upright in his cabin; but in consequence of the entreaties of an old servant, the admiral was at length prevailed on to allow it to be removed. Our readers will not be surprised that Lord Nelson should now be regarded as the great defence of the empire, and the support of her national glory. It is to his gallantry and naval skill that we are indebted for the victory of Copenhagen, and the annihilation of that formidable northern confederacy which menaced the prosperity, the commerce, the very existence of the rest of Europe.

One of the most important services which Lord Nelson performed, was the pursuit of the combined fleets of France and Spain to the West Indies. This fleet had sailed from Cadiz on the 10th of April, and it was at first conjectured that Egypt was the place of their destination. In consequence of this conjecture, Lord Nelson sailed in pursuit of the enemy for the coast of Egypt; and, having missed his object, after reconnoitring that coast, he passed the straits of Gibraltar, and anchored in Lagos bay on the 10th of May; soon after which he sailed for the West Indies with ten ships of the line; arrived off Barbadoes on the 4th of June; and having touched at Tobago, Trinidad, and Grenada, at the latter of which places he was informed that the combined fleet had been seen on the 6th off Dominica; he reached Antigua on the 12th, where he received information that the enemy had been seen on the 8th standing to the northward. Lord Nelson, without the loss of a moment, continued the pursuit of the enemy on their return to Europe, where they arrived about the end of July; and after taking in provisions and water at Gibraltar, and reconnoitring the harbour of Cadiz; he returned to England, where he arrived in the Victory, on the 18th of August, after having been engaged for nearly four months in one of the most arduous, and, at the same time, one of the most important and beneficial, although, in its immediate object, unsuccessful enterprises, for which his life was distinguished. Nelson. His lordship had now been absent from England more than two years, on the Mediterranean station.

The concluding scene of this extraordinary man's naval career, kindles emotions of admiration and regret; and at once excites both transport and extreme of sorrow. Perhaps no action, in point of splendour and magnanimity, can equal that which deprived his country of one of the greatest heroes it ever produced. Britons appear to be sensible of its vast importance; yet it is not improbable that posterity will consider it as still more splendid, their love and admiration not being damped by the poignant recollection that they personally saw the man by whose loss it was accomplished. When Lord Nelson perceived that, in consequence of his manœuvres, he had reduced the enemy to the absolute necessity of engaging him, he exclaimed in the presence of Captain Hardy and the other officers who surrounded him on the quarter deck; "Now they cannot escape us; I think we shall at least make sure of twenty of them.—I shall probably lose a leg, but that will be purchasing a victory cheaply." But alas! amidst the inexpressible satisfaction and delight, which a victory so splendid could not fail to inspire, he has left us to lament that it was purchased by the loss of a life so incomparably valuable.

His lordship's flag ship fell on board the Redoubtable, by which means he was exposed to the fire of the musketry from the tops; and the insignia of his grandeur and dignity, it is supposed, singled him out to the aims of the enemy, which in the issue were too fatally successful. His secretary was cut in two by his side with a chain shot, and soon after a ball grazed his lordship's shoulder, entered his left breast, and passed through his lungs. He lived about three hours after this tragical event, during which he remained perfectly recollected, and he displayed the same heroic magnanimity in the arms of death, which had so eminently distinguished him through the whole of his career. His last words to Captain Hardy were, "I know I am dying. I could have wished to survive to breathe my last upon British ground, but the will of God be done!" In a few moments he expired. His last signal ought not, and will not be forgotten, which was by telegraph,—"That England expected every man would do his duty." He spoke in raptures concerning the event of the day only a short time before his dissolution, and sent word to Admiral Collingwood, desiring that he would make his affectionate farewell to all his brother seamen throughout the fleet. In this manner died, in the 47th year of his age, the greatest commander that perhaps ever adorned the British navy, leaving behind him a name dear to Great Britain, and an example of heroism which will inspire his companions in arms to emulate his virtues, that they too may live in the remembrance of a grateful posterity.

His singular plan of attack on this memorable occasion was communicated by his lordship to all his captains, who unanimously gave it as their opinion that it could not possibly fail of success, being concerted with such consummate wisdom; and they even pledged their lives for the favourable result of it. His titles were, Viscount Nelson, and Duke of Bronté.—The united parliament voted him a pension of 3000l. a year, to continue during his own life and his two next heirs; the

East

Nelson || Nemean Games.

East India Company made him a present of 10,000l.; the grand signior gave him a diamond aigrette worth 4000l.; the emperor of Russia gave him a diamond box worth 2500l.; the king of Naples made him presents to the amount of 5000l. together with the dukedom of Bronté, and an estate of 3000l. per annum. Thus all Europe conspired to testify the estimation in which they held this distinguished hero; and the numerous monuments which have been, and still are erecting to his memory throughout the British empire, will continue lasting evidences of the esteem in which he was held by his grateful country. Parliament also voted a sum for the purchase of an estate for his heirs, and his majesty conferred the title of earl on his immediate successor.

Nor were his talents wholly confined to the knowledge of naval tactics, for it is known that as a senator he was highly respectable, although he enjoyed few opportunities of coming forward in that capacity. When he did, his speeches were heard by their lordships with respect, and the most profound attention. The few specimens we have of his abilities as a politician, afford no mean proof that if he had devoted as much of his time to those studies as he did to his peculiar profession, he would have made a distinguished figure in the house of peers.

NEMAUSIS, or NEMAUSUM, in *Ancient Geography*, the capital of the Arecomici in Gallia Narbonensis; a colony, (Coin), with the surname of *Augusta*, (Inscription). In it stands a Roman amphitheatre, which is still almost entire. Now *Nismes* in Languedoc.

NEMEA (Strabo, Livy); a river of Achaia, running between Sicyon and Corinth, the common boundary of both territories, and falling into the Corinthian bay.

NEMEA, in *Ancient Geography*, situated between Cleonæ and Philus in Argolis; whether town, district, or other thing, uncertain; there a grove stood in which the Argives celebrated the Nemean games, and there happened all the fabulous circumstances of the Nemean lion. The district Nemea is called *Bembinadia*, (Pliny); a village, *Bembina*, standing near Nemea, (Strabo). Stephanus places Nemea in Elis; though not in Elis, but on its borders; Pliny, erroneously in Arcadia. In the adjoining mountain is still shown the den of the lion, distant 15 stadia from the place *Nemea*, (Pausanias); in which stands a considerable temple of Jupiter Nemæus and Cleonæus, from the vicinity of these two places. This place gave name to the Nemæan games, celebrated every third year.

NEMEAN GAMES, so called from Nemea, a village between the cities of Cleonæ and Philus, where they were celebrated every third year. The exercises were chariot-races, and all the parts of the Pentathlum. These games were instituted in memory of Opheltes or Archemorus the son of Euphetes and Creusa, and who was nursed by Hypsipele; who leaving him in a meadow while she went to show the besiegers of Thebes a fountain, at her return found him dead, and a serpent twined about his neck: whence the fountain, before called *Langia*, was named *Archemorus*; and the captains, to comfort Hypsipele, instituted these games.— Others ascribe their institution to Hercules, after his victory over the Nemean lion. Others allow, that they were instituted first in honour of Archemorus; but intermitted, and revived again by Hercules. The victors were crowned with parsley, an herb used at funerals, and feigned to have sprung from Archemorus's blood. The Argives presided at these games.

Nemean Games || Nemesius.

NEMESIANUS, AURELIUS OLYMPIUS, a Latin poet who was born at Carthage, and flourished about the year 281, under the emperor Carus, and his sons Carinus and Numerian: the last of which emperors was so fond of poetry, that he contested the glory with Nemesianus, who had written a poem upon fishing and maritime affairs. We have still remaining a poem of our author called *Cynegeticon*, and four eclogues: they were published by Paulus Manutius in 1538; by Barthelet in 1613; at Leyden in 1653; with the notes of Janus Vlitias. Giraldi hath preserved a fragment of Nemesianus, which was communicated to him by Sannazarius, to whom we are obliged for our poet's works: for having found them written in Gothic characters, he procured them to be put into the Roman, and then sent them to Paulus Manutius. Although this poem hath acquired some reputation, it is greatly inferior to those of Oppian and Gratian upon the same subject; yet Nemesianus's style is natural enough, and has some degree of elegance. The world was so much possessed with an opinion of his poem in the eighth century, that it was read among the classics in the public schools, particularly in the time of Charlemagne, as appears from a letter of the celebrated Hincmar bishop of Rheims, to his nephew Hincmar of Laon.

NEMESIS, in Pagan worship, the daughter of Jupiter and Necessity, or, according to others, of Oceanus and Nox, had the care of revenging the crimes which human justice left unpunished. She was also called *Adrastæa*, because Adrastus king of Argos first raised an altar to her; and *Rhamnusia*, from her having a magnificent temple at Rhamnus in Attica. She had likewise a temple at Rome in the Capitol. She is represented with a stern countenance, holding a whip in one hand and a pair of scales in the other.

NEMESIUS, a Greek philosopher who embraced Christianity, and was made bishop of Emesa in Phœnicia, where he had his birth; he flourished in the beginning of the fifth century. There is a work of his extant, entitled *De Natura Hominis*, in which he refutes the fatality of the Stoics and the errors of the Manichees, the Apollinarists, and the Eunomians; but he espouses the opinion of Origen concerning the pre-existence of souls (A). This treatise was translated by Valla, and printed in 1535. Another version was afterwards made of it by Ellebodius, and printed in 1665; it is also inserted in the *Bibliotheca Patrum*, in Greek and Latin. Lastly, Another edition was published at Oxford in 1671, folio, with a learned preface, wherein the editor endeavours to prove, from a passage in this book, that the

(A) It is much more probable that he and Origen both brought their opinion with them from the schools of philosophy, than that either of them borrowed it from the other. See METAPHYSICS, Part III. Chap. IV.

Nemesius || Neomenia.

the circulation of the blood was known to Nemesius; which, however, was since shown to be a mistake by Dr Freind, in his *History of Physic*.

NEMINE CONTRADICENTE, "none contradicting it;" a term chiefly used in parliament when any thing is carried without opposition.

NEMOURS, a town in France, in the department of Seine and Marne, containing 3469 inhabitants in 1800. It is seated on the river Loing, in E. Long 2. 45. N. Lat. 48. 15.

NENAGH, a post and fair town of Ireland, in the county of Tipperary, and province of Munster, 75 miles from Dublin. It is situated on a branch of the river Shannon which runs into Lough-Derg. Here stand the ruins of an old castle called Nenagh-round. Also those of an hospital founded in the year 1200, for canons following the rule of St Augustin. It was dedicated to St John the Baptist, and was usually called *Teachon*, or St John's house. In the reign of Henry III. a friary for conventual Franciscans was also founded here, and esteemed the richest foundation of that order in the kingdom. Here is a barrack for two troops of horse. This town was burnt on St Stephen's day, 1348, by the Irish. The fairs held here are four.

NENIA, or NÆNIA, in the ancient poetry, a kind of funeral song sung to the music of flutes at the obsequies of the dead. Authors represent them as sorry compositions, sung by hired women mourners called *Præficæ*. The first rise of these Nenia is ascribed to the physicians. In the heathen antiquity, the goddess of tears and funerals was called *Nenia*; whom some suppose to have given that name to the funeral song, and others to have taken her name from it.

NEOCESARIA, (Pliny), a town of Pontus on the south or the left side of the Lycus. About the year 342, when Leontius and Sallustius were consuls, it was entirely ruined by a dreadful earthquake, no edifice having withstood the violence of the shock, except the church and the bishop's habitation, who was saved, with the clergy and some other pious persons, while the rest of the inhabitants were buried in its ruins.

NEOMAGUS, (Ptolemy); NOVIOMAGUS, (Antonine); a town of the Regni in Britain: now thought to be Guildford in Surry, (Lhuyd); or Croydon, (Talbot). But Camden takes it to be Woodcote, two miles to the south of Croydon, where traces of an ancient town are still to be seen.

NEOMAGUS, (Ptolemy); *Noviomagus* (Antonine); a town of the Treviri on the Moselle. Now *Numagen* 14 miles east, below Triers.

NEOMAGUS, (Ptolemy); *Noviomagus Lexoviorum*, (Antonine); a town of Gallia Celtica. Now *Lisieux*, in Normandy.

NEOMAGUS, (Ptolemy); *Noviomagus Nemetum*, (Antonine). Now *Spire*, a city of the Palatinate, on the left or west side of the Rhine.

NEOMAGUS, (Ptolemy); a town of Gallia Narbonensis, on the confines of the Tricastini. Now *Nyons* in Dauphine.

NEOMENIA, or NOUMENIA, a festival of the ancient Greeks, at the beginning of every lunar month, which, as the name imports, was observed upon the day of the new moon, in honour of all the gods, but especially Apollo, who was called *Neomenios*, because the sun is the fountain of light; and whatever distinction of times and seasons may be taken from other planets, yet they are all owing to him as the original of those borrowed rays by which they shine. The games and public entertainments at these festivals were made by the rich, to whose tables the poor flocked in great numbers. The Athenians at these times offered solemn prayers and sacrifices for the prosperity of their country during the ensuing month. See GAMES.

Neomenia || Nepal.

The Jews had also their neomenia, or feast of the new moon, on which peculiar sacrifices were appointed: and on this day they had a sort of family entertainment and rejoicing. The most celebrated neomenia of all others was that at the beginning of the civil year, or first day of the month Tisri, on which no servile labour was performed: they then offered particular burnt sacrifices, and sounded the trumpets of the temple. The modern Jews keep the neomenia only as a feast of devotion, which any one may observe or not as he pleases.

NEOPHYTES, "new plants;" a name given by the ancient Christians to those heathens who had newly embraced the faith; such persons being considered as regenerated, or born anew by baptism. The term *neophytes* has been also used for new priests, or those just admitted into orders, and sometimes for the novices in monasteries. It is still applied to the converts made by the missionaries among the infidels.

NEPA, a genus of insects belonging to the order of hemiptera. See ENTOMOLOGY *Index*.

NEPAL, a kingdom of India, to the north-east of the city of Patna, inclosed among the secondary branches of the Himmalch mountains, of great extent from east to west, but scarcely exceeding a degree of latitude in breadth. The height of the country above the sea, as indicated by the barometer, is not less than 4000 feet; yet Colonel Kirkpatrick found the thermometer on one occasion at 87°. But the neighbouring mountains afford the inhabitants every variety of climate, from the heat of Bengal to the cold of Russia. The high grounds are very healthy; in the valleys fever prevails; guttural tumours or *goitres* are found in both. Iron and copper abound in this country. Though stones are found, the houses are built of brick, cemented with mud. The cattle are similar to those of Bengal, and the honey is excellent. The soil is fertile, and besides wheat, rice, and sugar, yields the Zooral a species of yam, and the Kuraila a kind of wild asparagus, which form a considerable part of the subsistence of the poorer inhabitants.

The inhabitants consist principally of the two superior classes of Hindoos, and a race called Newars, who are probably of Chinese or Tartar origin. The former, who compose the army, engross all situations of trust, and are found dispersed all over the country. The Newars are confined almost entirely to the valley of of Nepal Proper. The latter are divided into several castes or orders. The total population is estimated at about half a million. The Newars are a peaceable and industrious people, of a middle size, with broad shoulders and chests, very stout limbs, round and flat faces, but open and cheerful. The Newar women change their husbands as often as they please on the slightest pretences. The religion of the country is the same as the Hinduism of Bengal. The government is despotic. The trade is inconsiderable, being crushed by monopolies.

Khatmandu, the capital, is supposed to contain about

Nepal || Nepos.

50,000 inhabitants. It abounds in wooden temples, which are so numerous, that Colonel Kirkpatrick says, there are almost as many of them as of houses.

NEPENTHES, a genus of plants belonging to the gynandria class; and in the natural method ranking among those of which the order is doubtful. See BOTANY *Index*.

NEPETA, CATMINT, or *Nep*, a genus of plants belonging to the didynamia class, and in the natural method ranking under the 42d order, *Verticillatæ*. See BOTANY *Index*.

NEPHELIUM, a genus of plants belonging to the monœcia class. See BOTANY *Index*.

NEPHEW, a term relative to uncle and aunt, signifying a brother's or sister's son; who, according to the civil law, is in the third degree of consanguinity, but according to the canon in the second.

NEPHRITIC, something that relates to the kidneys. See KIDNEY.

Nephritic Wood, (lignum nephriticum), a wood of a very dense and compact texture, and of a fine grain, brought to us from New Spain in small blocks, in its natural state, and covered with its bark. This wood is said to be a good diuretic; and we are told it is used among the Indians in all diseases of the kidneys and bladder, and in suppression of urine, from whatever cause. It is also recommended in fevers, and in obstructions of the viscera. The way of taking it among the Indians is only an infusion in cold water. These uses are not however properly ascertained. See GUILANDINA, BOTANY *Index*.

Nephritic Stone. See NEPHRITE or *Jade*, MINERALOGY *Index*.

NEPHRITICS, in *Pharmacy*, medicines proper for diseases of the kidneys. See MATERIA MEDICA *Index*.

NEPHRITIS, or inflammation of the kidneys. See MEDICINE *Index*.

NEPOS, CORNELIUS, a celebrated Latin biographer, who flourished in the time of Julius Cæsar, and lived, according to St Jerome, to the sixth year of Augustus. He was an Italian, if we may credit Catullus, and born at Hostilia, a small town in the territory of Verona, in Cisalpine Gaul. Ausonius, however, will have it that he was born in the Gauls. Leander Alberti thinks Nepos's country was Verona. Cicero and Atticus were friends of our author; who wrote the lives of the Greek historians, as he himself attests in that of Dion, speaking of Philistus. What he says, also, in the lives of Cato and Hannibal, proves that he had also written the lives of the Latin captains and historians. He wrote some other excellent works which are lost.

All that we have left of his at present is, "The Lives of the illustrious Greek and Roman Captains;" which were a long time ascribed to Æmilius Probus, who published them, as it is said, under his own name, to insinuate himself thereby into the favour of the emperor Theodosius; but, in the course of time, the fraud has been discovered, although several learned persons have confounded the two authors. This piece has been translated into French by the Sieur de Claveret, with a dedication to the duke of Longueville, in 1663; and again by M. le Gras, then of the congregation of the Oratory at Paris, 1729, 12mo. We have an excellent translation of it into English, by several hands at Oxford, which has gone through several editions.

Neptune.

NEPTUNE, in Pagan worship, the god of the sea, was the son of Saturn and Vesta or Ops, and the brother of Jupiter and Pluto. He assisted Jupiter in his expeditions; on which that god, when he arrived at the supreme power, assigned him the sea and the islands for his empire. He was, however, expelled from heaven with Apollo for conspiring against Jupiter, when they were both employed by Laomedon king of Phrygia in building the walls of Troy; but that prince dismissing Neptune without a reward, he sent a sea monster to lay waste the country, on which he was obliged to expose his daughter Hesione. He is said to have been the first inventor of horsemanship and chariot racing; on which account Mithridates king of Pontus threw chariots drawn by four horses into the sea in honour of this god; and the Romans instituted horse races in the circus at his festival, during which all other horses left working, and the mules were adorned with wreaths of flowers.

In a contest with Minerva he produced a horse by striking the earth with his trident; and on another occasion, in a trial of skill with Minerva and Vulcan, produced a bull, whence that animal was sacrificed to him. His favourite wife was Amphytrite, whom he long courted in vain, till sending a dolphin to intercede for him, he met with success; on which he rewarded the dolphin by placing him among the stars. He had also two other wives, one of whom was called *Salasia* from the salt water; the other *Venilia* from the ebbing and flowing of the tides. He had likewise many concubines, by whom he had a great number of children. He is represented with black hair, with a garment of an azure or sea green: holding his trident in his hand, and seated in a large shell drawn by sea horses: attended by the sea gods Palemon, Glaucus, and Phorcys, and the sea goddesses Thetis, Melita, and Panopæa, and a long train of tritons and sea nymphs.

This deity was known in Egypt by the name of *Cenobus* or *Canopus*, and was worshipped as the *numen aquarum* or spirit of the Nile. His emblem was the figure of certain vases or pitchers, with which the Egyptians filtrated the water of the sacred river, in order to purify and render it fit for use. From the mouth of each of these vases, which were charged with hieroglyphics, arose the head and sometimes the head and hands of a man or woman. Such are the emblems which still remain of the Egyptian Neptune or Canobus; and it was by this emblem that the tutelar god of Egypt vanquished the god of Chaldea in the ridiculous manner mentioned by Ruffinus in his Ecclesiastical History*.

"The Chaldeans (says he) who adored the fire, carried their god into various countries that he might try his strength in contests with other gods. He vanquished, as we may easily conceive, the images made of gold, silver, brass, and wood, &c. by reducing them to ashes; and thus the worship of fire was everywhere established. The priest of Canobus, unwilling, as became him, to admit the superiority of strange gods, contrived to make his god vanquish the god of Chaldæa in a pitched battle. The vases which were worshipped as the emblems of Canobus, being used for filtering the waters of the Nile, were of course perforated on all sides with very small holes. This faithful priest having stopped all the holes in one of these

* Lib. x. cap. 26.

Neptune || Nero.

these with wax, and painted the vase of different colours for a reason which the reader will admit to be a good one, filled it up with water, and fitted to its mouth the head of an idol. This emblem of Canobus was then placed in a small fire brought by the Chaldeans as the emblem of their god; and thus the gods of Egypt and Chaldea were forced into battle. The contest, however, was of short duration. The heat melting the wax made way for the water to run out, which quickly extinguished the fire; and thus Canobus vanquished the god of the Chaldeans." Ridiculous as this story is, it is perfectly suitable to the genius of Paganism, and the mean artifices of the Pagan priesthood; but we suspect that the historian laboured under one mistake, and substituted the Chaldeans instead of the Persians. See POLYTHEISM.

NEREIDS, in the Pagan theology, sea nymphs, daughters of Nereus and Doris.—The Nereids were esteemed very handsome; insomuch that Cassiope, the wife of Cepheus king of Ethiopia, having triumphed over all the beauties of the age, and daring to vie with the Nereids, they were so enraged that they sent a prodigious sea monster into the country, and, to appease them, she was commanded by the oracle to expose her daughter Andromeda, bound to a rock, to be devoured by the monster. In ancient monuments, the Nereids are represented riding upon sea horses; sometimes with an entire human form, and at other times with the tail of a fish.

NEREIS, a genus of animals belonging to the order of vermes mollusca. See HELMINTHOLOGY *Index*.

NEREUS, in fabulous history, a marine deity, was son of Oceanus and Thetis. He settled in the Ægean sea, was considered as a prophet, and had the power of assuming what form he pleased. He married his sister Doris, by whom he had 50 daughters called the *Nereids*, who constantly attended on Neptune, and when he went abroad surrounded his chariot.

NERI, ANTHONY, a learned writer who published a curious book printed at Florence 1612, in 4to, with this title, *Dell' Arte Verraria Libri VII.*; or *the Art of Glassmaking*.

NERIUM, a genus of plants belonging to the pentandria class; and in the natural method ranking under the 30th order, *Contortæ*. See BOTANY and DYEING *Index*.

NERO, CLAUDIUS DOMITIUS CÆSAR, a celebrated Roman emperor, son of Caius Domitius Ahenobarbus and Agrippina the daughter of Germanicus. He was adopted by the emperor Claudius, A. D. 50, and four years after he succeeded him on the throne. In the beginning of his reign he showed several marks of the greatest kindness and condescension, affability, complaisance, and popularity. The object of his administration seemed to be the good of his people; and when he was desired to sign his name to a list of malefactors that were to be executed, he exclaimed, *Would to heaven I could not write!* He hated flattery; and when the senate had liberally commended the wisdom of his government, he desired them to keep their praises till he deserved them. These promising virtues soon, however, proved to be artificial: Nero soon displayed the real propensities of his nature. He delivered himself from the sway of his mother, and at last ordered her to be murdered. This unnatural act of barbarity might astonish some, but Nero had his devoted adherents; and when he declared that he had taken away his mother's life to save himself from ruin, the senate applauded his measures, and the people signified their approbation. Many of his courtiers shared her unhappy fate; and Nero sacrificed to his fury or caprice all such as obstructed his pleasure or diverted his inclination. In the night he generally went from his palace to visit the meanest taverns, and all the scenes of debauchery which Rome contained. In this nocturnal riot he was fond of insulting the people in the streets; and his attempts to offer violence to the wife of a Roman senator nearly cost him his life. He also turned actor, and openly appeared on the Roman stage in the meanest characters. In his attempts to excel in music, and to conquer the disadvantages of a hoarse disagreeable voice, he moderated his meals, and often passed the day without eating. The Olympian games attracted his notice: he went into Greece, and presented himself a candidate for the public honour. He was defeated in wrestling; but the flattery of the spectators adjudged him the victory, and he returned to Rome with all the splendour and pomp of an eastern conqueror, drawn in the chariot of Augustus, and attended by a band of musicians, actors, and stage dancers from every part of the empire. These private and public amusements of the emperor were indeed innocent; his character only was injured, and not the lives of the people. His conduct, however, soon became more abominable: he disguised himself in the habit of a woman, and was publicly married to one of his eunuchs. This violence to nature and decency was soon exchanged for another: Nero resumed his sex, and celebrated his nuptials with one of his meanest catamites: and it was on this occasion that one of the Romans observed that the world would have been happy if Nero's father had had such a wife. But his cruelty was now displayed in a still higher degree, for he sacrificed to his wantonness his wife Octavia Poppæa, and the celebrated writers Seneca, Lucan, Petronius, &c. Nor did the Christians escape his barbarity. He had heard of the burning of Troy; and as he wished to renew that dismal scene, he caused Rome to be set on fire in different places. The conflagration became soon universal, and during nine successive days the fire continued. All was desolation: nothing was heard but the lamentations of mothers whose children had perished in the flames, the groans of the dying, and the continual fall of palaces and buildings. Nero was the only one who enjoyed the general consternation. He placed himself on the top of a high tower, and he sung on his lyre the destruction of Troy, a dreadful scene which his barbarity had realized before his eyes. He attempted to avert the public odium from his head by a pretended commiseration of the miseries of his subjects. He began to repair the streets and public buildings at his own expence. He built himself a celebrated palace, which he called his golden house. It was liberally adorned with gold, with precious stones, and with every thing rare and exquisite. It contained spacious fields, artificial lakes, woods, gardens, orchards, and whatever exhibited a beautiful scene. The entrance of this edifice could admit a large colossus of the emperor 120 feet high; the galleries were each a mile long, and the whole was covered with

Nero.

Nero. gold. The roofs of the dining halls represented the firmament, in motion as well as in figure; and continually turned round night and day, showering down all sorts of perfumes and sweet waters. When this grand edifice, which, according to Pliny, extended all round the city, was finished, Nero said, that now he could lodge like a man. His profusion was not less remarkable in all his other actions. When he went a fishing his nets were of gold and silk. He never appeared twice in the same garment, and when he took a voyage, there were thousands of servants to take care of his wardrobe. This continuation of debauchery and extravagance at last roused the people. Many conspiracies were formed against him; but they were generally discovered, and such as were accessory suffered the severest punishments. The most dangerous conspiracy against Nero's life was that of Piso, from which he was saved by the confession of a slave. The conspiracy of Galba proved more successful, who, when he was informed that his plot was known to Nero, declared himself emperor. The unpopularity of Nero favoured his cause; he was acknowledged by all the Roman empire, and the senate condemned the tyrant to be dragged naked through the streets of Rome, and whipped to death, and afterwards to be thrown down from the Tarpeian rock like the meanest malefactor. This, however, was not executed; for Nero prevented it by a voluntary death. He killed himself, A. D. 68, in the 32d year of his age, after a reign of of 13 years and eight months. Rome was filled with acclamations on the occasion; and the citizens, more strongly to indicate their joy, wore caps, such as were generally used by slaves who had received their freedom. Their vengeance was not only exercised against the statues of the deceased monster, but many of his friends were the object of the public resentment; and many were crushed to pieces in such a violent manner, that one of the senators, amid the universal joy, said that he was afraid they should soon have cause to wish for Nero. The tyrant, as he expired, requested that his head might not be cut off from his body, and exposed to the insolence of the populace, but that the whole might be burned on the funeral pile. His request was granted by one of Galba's freedmen, and his obsequies were performed with the usual ceremonies. Though his death seemed to be the source of general gladness, yet many of his favourites lamented his fall, and were grieved to see that their pleasures and amusements were stopped by the death of this patron of debauchery and extravagance. Even the king of Parthia sent ambassadors to Rome, to condole with the Romans, and to beg that they would honour and revere the memory of Nero. His statues were also crowned with garlands of flowers; and many imagined that he was not dead, but that he would soon make his appearance and take vengeance on his enemies. It will be sufficient to observe, in finishing the character of this tyrannical monster, that the name of Nero is even now used emphatically to express a barbarous and unfeeling oppressor. Pliny calls him the common enemy and fury of mankind; and so indeed he has been called by all writers, who exhibit Nero as a pattern of the most execrable barbarity and unpardonable wantonness. The same Pliny furnishes us with this singular anecdote of him: "Nero had ordered himself to be painted under the figure of a colossus, upon cloth or canvas, 120 feet in height." He adds, "that this preposterous picture, when it was finished, met with its fate from lightning, which consumed it, and involved likewise the most beautiful part of the gardens where it was placed in the conflagration." Nero || Nessus.

NERVA, Cocceius, a Roman emperor after Domitian, who was the last of the 12 Cæsars. He was a native of Narnia in Umbria; his family, however, was originally of Crete. Dion Cassius says he was born on the 17th of March, in the 18th year of Tiberius's reign, and of the Christian era the 32d. Nero in the 12th year of his reign made him prætor, and erected a statue for him in the palace on account of his poems (for he was one of the best poets of his age), some of which were inscribed to him. He was consul in 71 with Vespasian, and in 90 with Domitian.

Ancient authors uniformly celebrate him as a prince of a most mild and humane temper, of great moderation and generosity, who looked on his office as emperor, not as if it was for his own advantage, but for that of his people; and whilst he reigned, which was however but for a short time, he made the happiness of his subjects his only end and pursuit. He narrowly escaped death under Domitian; was naturally of a weak and timorous disposition; and, as some say, addicted to excessive drinking. The Romans unanimously chose him emperor; and they had no cause to repent of their choice, for he was constantly attentive to what could make them happy; he was generous, merciful, and disinterested. An instance of his great lenity appears in his pardoning Calpurnius Crassus who conspired against him. In short, he omitted nothing that might contribute to the restoring of the empire to its former lustre: recalling those who had been banished for religion, and redressing all grievances that came to his knowledge. He however found his strength failing, and that it would be impossible for him to finish his designs, in consequence of which he adopted Trajan. After his death, which happened in the year 98, he was ranked among the gods. He was the first Roman emperor of foreign extraction.

NERVES, in *Anatomy*, certain white glistening cords, proceeding from the brain and spinal marrow, and dividing into very small branches, which are sent off throughout all parts of the body; and which are found to be the organs of sensation and motion. See Anatomy *Index*.

Nervous fluid. See Anatomy *Index*.

Nessus, in fabulous history, a celebrated Centaur, son of Ixion and a Cloud. He offered violence to Dejanira, whom Hercules had intrusted to his care, with orders to carry her across the river Evenus. Hercules saw the distress of his wife from the opposite shore of the river, and immediately he let fly one of his poisoned arrows, which struck the Centaur to the heart. Nessus, as he expired, gave the tunic he then wore to Dejanira, assuring her that from the poisoned blood which had flowed from his wounds, it had received the power of calling a husband away from unlawful loves. Dejanira received it with pleasure, and this mournful present caused the death of Hercules.——A river which separates Thrace from Macedonia. It is also called *Nesus*, *Nestos*, and *Nestus*.

Nest, Nestor.

NEST. See NIDUS.

Eatable Birds NESTS. See *Birds Nests.*

NESTOR, in fabulous history, a son of Neleus and Chloris, nephew to Pelias and grandson to Neptune. He had eleven brothers, who were all killed with his father by Hercules. His tender age detained him at home, and was the cause of his preservation. The conqueror spared his life and placed him upon the throne of Pylos. He married Eurydice the daughter of Clymenus; or, according to others, Anaxibia the daughter of Atreus. He soon distinguished himself in the field of battle; and was present at the nuptials of Perithous, when a bloody engagement took place between the Lapithæ and Centaurs. As king of Pylos and Messenia he led his subjects to the Trojan war, where he distinguished himself among the rest of the Grecian chiefs, by eloquence, address, wisdom, justice, und uncommon prudence. Homer displays his character as the most perfect of all his heroes; and Agamemnon exclaims, that if he had 20 generals like Nestor, he should soon see the walls of Troy reduced to ashes. After the Trojan war Nestor retired to Greece, where he enjoyed in the bosom of his family the peace and tranquillity which were due to his wisdom and to his age. The manner and the time of his death are unknown: the ancients are all agreed that he lived three generations of men; which length of time is supposed to be 300 years, though more probably only 90 years, allowing 30 years for each generation. From that circumstance, therefore, it was usual among the Greeks and the Latins, when they wished a long and happy life to their friends, to wish them to see the years of Nestor. He had many children; two daughters, Pisidice, and Polycaste; and seven sons, Perseus, Straticus, Aretus, Echephron, Pisistratus, Antilochus, and Thrasymedes. Nestor was one of the Argonauts, according to Valerius Flaccus, v. 380, &c.—A poet of Lycaonia in the age of the emperor Severus. He was father to Pisander, who under the emperor Alexander wrote some fabulous stories.——One of the body guards of Alexander.

NESTOR, whose secular name is not known, was a native of Russia, and the earliest historian of the north. He was born in 1056 at Bielozero; and in the 19th year of his age he assumed the monastic habit in the convent of Petcherski at Kiof, and took the name of *Nestor*. He there made a considerable proficiency in the Greek language: but seems to have formed his style and manner rather from the Byzantine historians, Cedrenus, Zonaras, and Syncellus, than from the ancient classics. The time of Nestor's death is not ascertained; but he is supposed to have lived to an advanced age, and to have died about the year 1115.

His great work is his Chronicle, to which he has prefixed an introduction, which after a short sketch of the early state of the world, taken from the Byzantine writers, contains a geographical description of Russia and the adjacent regions; an account of the Sclavonian nations, their manners, their emigrations from the banks of the Danube, their dispersion, and settlement in the several countries wherein their descendants are now established. He then enters upon a chronological series of the Russian annals, from the year 858 to about 1113. His style is simple and unadorned, such as suits a mere recorder of facts; but his chronological exactness, though it renders his narrative dry and tedious, contributes to ascertain the era and authenticity of the events which he relates.

Nestor, Nestorians.

It is remarkable (says Mr Coxe, from whom we have taken this narrative), that an author of such importance, whose name frequently occurs in the early Russian books, should have remained in obscurity above 600 years; and been scarcely known to his modern countrymen, the origin and actions of whose ancestors he records with such circumstantial exactness. A copy of his Chronicle was given in 1668 by Prince Radzivil to the library of Konigsburg, where it lay unnoticed till Peter the Great, in his passage through that town, ordered a transcript of it to be sent to Petersburgh. But it still was not known as the performance of Nestor: for when Muller in 1732 published the first part of a German translation, he mentioned it as the work of the abbot Theodosius of Kiof; an error which arose from the following circumstance: The ingenious editor not being at that time sufficiently acquainted with the Sclavonian tongue, employed an interpreter, who, by mistaking a letter in the title, supposed it to have been written by a person whose name was Theodosius. This ridiculous blunder was soon circulated and copied by many foreign writers, even long after it had been candidly acknowledged and corrected by Muller.

NESTORIANS, a sect of ancient Christians, still said to be subsisting in some parts of the Levant; whose distinguishing tenet is, that Mary is not the mother of God. They take their name from Nestorius bishop of Constantinople, whose doctrines were spread with much zeal through Syria, Egypt, and Persia.

One of the chief promoters of the Nestorian cause was Barsumas, created bishop of Nisibis, A. D. 435. Such was his zeal and success, that the Nestorians, who still remain in Chaldea, Persia, Assyria, and the adjacent countries, consider him alone as their parent and founder. By him Pherozes the Persian monarch was persuaded to expel those Christians who adopted the opinions of the Greeks, and to admit the Nestorians in their place, putting them in possession of the principal seat of ecclesiastical authority in Persia, the see of Seleucia, which the patriarch of the Nestorians has always filled even down to our time.—Barsumas also erected a school at Nisibis, from which proceeded those Nestorian doctors who in the fifth and sixth centuries spread abroad their tenets through Egypt, Syria, Arabia, India, Tartary, and China.

He differed considerably from Nestorius, holding that there are two persons in Jesus Christ, as well as that the Virgin was not his mother, as God, but only as man.

The abettors of this doctrine refuse the title Nestorians; alleging that it had been handed down from the earliest times of the Christian church.

In the tenth century, the Nestorians in Chaldea, whence they are sometimes called *Chaldeans*, extended their spiritual conquests beyond Mount Imaus, and introduced the Christian religion into Tartary properly so called, and especially into that country called *Karit*, bordering on the northern part of China. The prince of that country, whom the Nestorians converted to the Christian faith, assumed, according to the vulgar tradition, the name of *John* after his baptism, to which he added

Nestorians, Nestorius.

added the surname of *Presbyter*, from a principle of modesty; whence it is said his successors were each of them called *Prester John* until the time of Gengis Khan. But Mosheim observes, that the famous Prester John did not begin to reign in that part of Asia before the conclusion of the 11th century. The Nestorians formed so considerable a body of Christians, that the missionaries of Rome were industrious in their endeavours to reduce them under the papal yoke. Innocent IV. in 1246, and Nicolas IV. in 1278, used their utmost efforts for this purpose, but without success. Till the time of Pope Julius III. the Nestorians acknowledged but one patriarch, who resided first at Bagdad, and afterwards at Mousul; but a division arising among them, in 1551 the patriarchate became divided, at least for a time, and a new patriarch was consecrated by that pope, whose successors fixed their residence in the city of Ormus in the mountainous part of Persia, where they still continue, distinguished by the name of *Simeon;* and so far down as the last century, these patriarchs persevered in their communion with the church of Rome, but seem at present to have withdrawn themselves from it. The great Nestorian pontiffs, who form the opposite party, and look with a hostile eye on this little patriarch, have since the year 1559 been distinguished by the general denomination of Elias, and reside constantly in the city of Mousul. Their spiritual dominion is very extensive, takes in a great part of Asia, and comprehends also within its circuit the Arabian Nestorians, and also the Christians of St Thomas, who dwell along the coast of Malabar. It is observed, to the lasting honour of the Nestorians, that of all the Christian societies established in the East, they have been the most careful and successful in avoiding a multitude of superstitious opinions and practices that have infected the Greek and Latin churches. About the middle of the 17th century, the Romish missionaries gained over to their communion a small number of Nestorians, whom they formed into a congregation or church; the patriarchs or bishops of which reside in the city of Amida, or Diarbekir, and all assume the denomination of *Joseph*. Nevertheless the Nestorians in general persevere to our own times in their refusal to enter into the communion of the Romish church, notwithstanding the earnest entreaties and alluring offers that have been made by the pope's legate to conquer their inflexible constancy.

NESTORIUS, from whom the sect of Nestorian Christians derive their name, was born in Germanica a city of Syria. He received his education at Antioch, where he was likewise baptized; and soon after his baptism he withdrew himself to a monastery in the suburbs of that city. Upon his being admitted to the order of priesthood, he quickly acquired so great reputation by the eloquence of his preaching, and the regularity of his life, that by the emperor Theodosius he was deemed a fit person to fill the second see in the Christian church, and was accordingly consecrated bishop of Constantinople in the year 429.

In one of his first sermons after his promotion, he publicly declared his intention to *make war upon heretics;* and with that intolerant spirit which has so often disgraced the preachers of the mild religion of Jesus, he called upon the emperor to *free the earth from heresies*, promising to give him heaven as a reward for his zeal. To this spiritual motive he added one, that, though carnal, he possibly judged of equal force:—"Join with me (said he) in war against them, and I will assist you against the Persians." Although the wiser and better part of his audience were amazed to see a man, before he had tasted (as the historian * expresses himself) the water of his city, declare that he would persecute all who were not of his opinion; yet the majority of the people approved of this discourse, and encouraged him to execute his purpose. Accordingly, five days after his consecration, he attempted to demolish the church in which the Arians secretly held their assemblies; and he succeeded so far in his design, that these people, growing desperate, set it on fire themselves, and consumed with it some of the neighbouring houses. This fire excited great commotions in the city, and Nestorius was ever afterwards called an *incendiary*.

Nestorius. * *Socrates.*

From the Arians he turned his persecution against the Novatians, but was stopped in his career by the interposition of the emperor. He then let loose his fury upon those Christians of *Asia*, *Lydia*, and *Caria*, who celebrated the feast of Easter upon the 14th day of the moon; and for this unimportant deviation from the Catholic practice, many of those people were murdered by his agents both at Miletum and Sardis.—One cannot be sorry that such a relentless persecutor should himself be afterwards condemned as a heretic, for holding an opinion which no man who speaks or thinks with philosophic accuracy will now venture to controvert. This obnoxious tenet, which produced a schism in the church, and was condemned by a general council, was nothing more than that "the Virgin Mary cannot with propriety be called the mother of God." The people being accustomed to hear this expression, were much inflamed against their bishop, imagining that he had revived the error of *Paulus Samosetenus* and *Photinus*, who taught that Jesus Christ was a mere man. The monks declared openly against him, and, with some of the most considerable men of Constantinople, separated themselves from his communion. Several bishops wrote to him earnest persuasives to acknowledge that Mary was the mother of God; and when he would not comply, they procured his condemnation in the council of Ephesus, which deprived him of his see. He then retired to his ancient monastery at Antioch, whence he was taken four years afterwards by the emperor's order, and banished in 435 to Tarsus. That city being taken and destroyed by the Barbarians, he was removed to Panopolis, a city of Thebais; where he was not suffered to remain long, but was compelled to go from place to place, till, being in one of his journeys mortally bruised by a fall, death relieved him from the fury of his persecutors.

If we examine such of his writings as remain, we shall find that he was very unjustly condemned. It appears that he rejected the errors of *Ebion*, *Paulus Samosetenus*, and *Photinus;* that he maintained in express terms, that the divine Word was united to the human nature in Jesus Christ in the most strict and intimate sense possible; that these two natures, in this state of union, make but one Christ and one person; that the properties of the Divine and human natures may both be attributed to this person; and that Jesus Christ may be said to have been born of a virgin, to have suffered

and

Nestorius || Net.

and died; but he never would admit that God could be said to have been born, to have suffered, or to have died.—When we consider that every person partakes of the substance of his mother, and that it is this which constitutes the parental and filial relation between them, it is indeed surprising that the expression "Mother of God" should ever have been admitted into the Christian church, or that any man who understands the meaning of the words should condemn Nestorius for not having used them.

NESTUS, or NESSUS, a river which separates Thrace from Macedonia. It falls into the Ægean sea near the island Thasos. It is sometimes called *Nesus* and *Nessus*.

NET, a device for catching fish and fowl. See the article FISHERY.

The taking fowls by nets is the readiest and most advantageous of all others, where numbers are to be taken. The making the nets is very easy, and what every true sportsman ought to be able to do for himself. All the necessary tools are wooden needles, of which there should be several of different sizes, some round and others flat; a pair of round pointed and flat scissars; and a wheel to wind off the thread. The packthread is to be of different strength and thickness, according to the sort of birds to be taken; and the general size of the meshes, if not for very small birds, is two inches from point to point. The nets should neither be made too deep nor too long, for they are then difficult to manage; and they must be verged on each side with twisted thread. The natural colour of the thread is too bright and pale, and is therefore in many cases to be altered. The most usual colour is the russet; which is to be obtained by plunging the net, after it is made, into a tanners pit, and letting it lie there till it be sufficiently tinged: this is of a double service to the net, since it preserves the thread as well as alters the colour. The green colour is given by chopping some green wheat and boiling it in water, and then soaking the net in this green tincture. The yellow colour is given in the same manner with the decoction of celandine; which gives a pale straw-colour, which is the colour of stubble in the harvest-time. The brown nets are to be used on ploughed lands, the green on grass grounds, and the yellow on stubble lands.

Day-NET, among fowlers, a net generally used for taking such small birds as play in the air, and will stoop either to prey, gig, or the like; as larks, linnets, buntings, &c. The time of the year for using this net is from August to November; and the best time is very early in the morning: and it is to be observed, that the milder the air, and the brighter the sun is, the better will be the sport, and of longer continuance. The place where this net should be laid, ought to be plain champaign, either on short stubbles, green leas, or flat meadows, near corn fields, and somewhat remote from towns and villages: you must be sure to let your net lie close to the ground, that the birds creep not out and make their escape.—The net is made of a fine packthread with a small mesh, not exceeding half an inch square; it must be three fathoms long, and but one broad: it must be verged about with a small but strong cord; and the two ends extended upon two small long poles, suitable to the breadth of the net, with four stakes, tail-strings, and drawing-lines.—This net is composed of two, which must be exactly alike; and are to be laid opposite to one another, so even and close, that when they are drawn and pulled over, the sides must meet and touch each other. You must stake this net down with strong stakes, very stiff on their lines, so that you may with a nimble touch cast them to and fro at pleasure; then fasten your drawing-cord or hand-lines (of which there must be a dozen at least, and each two yards long) to the upper end of the foremost staves: and so extend them of such a straitness, that with a little strength they may rise up in the nets and cast them over.

Net.

Your nets being thus laid, place your gigs, or playing-wantons, about 20 or 30 paces beyond, and as much on this side your nets: the gigs must be fastened to the tops of long poles, and turned into the wind, so as they may play to make a noise therein. These gigs are a sort of toys made of long goose-feathers, like shuttle-cocks, and with little small tunnels of wood running in broad and flat swan-quills, made round like a small hoop; and so, with longer strings fastened to a pole, will, with any small wind or air, move after such a manner, that birds will come in great flocks to play about them.

When you have placed your gigs, then place your stale; which is a small stake of wood, to prick down into the earth, having in it a mortice-hole, in which a small and slender piece of wood, about two feet long, is fastened, so as it may move up and down at pleasure: and fasten to this longer stick a small line, which, running through a hole in the stick above-mentioned, and so coming up to the place where you are to sit, you may, by drawing the line up and down with your right hand, raise up the longer stick as you see occasion.

Fasten a live lark, or such like bird, to this longer stick, which, with the line making it to stir up and down by your pulling, will entice the birds to come to your net.

There is another stale, or enticement, to draw on these birds, called a *looking-glass*; which is a round stake of wood, as big as a man's arm, made very sharp at the end, to thrust it into the ground: they make it very hollow in the upper part, above five fingers deep; into which hollow they place a three-square piece of wood about a foot long, and each two inches broad, lying upon the top of the stake, and going with a foot into the hollowness: which foot must have a great knob at the top, and another at the bottom, with a deep slenderness between; to which slenderness you are to fasten a small packthread, which, running through a hole in the side of the stake, must come up to the place where you sit. The three square piece of wood which lies on the top of the stake, must be of such a poise and evenness, and the foot of the socket so smooth and round, that it may whirl and turn round upon the least touch; winding the packthread so many times about it, which being suddenly drawn, and as suddenly let go, will keep the engine in a constant rotatory motion: then fasten with glue on the uppermost flat squares of the three-square piece, about 20 small pieces of looking-glass, and paint all the square wood between them of a light and lively red; which, in

Sportsman's Dictionary.

Net, Netherlands.

the continual motion, will give such a reflection, that the birds will play about to admiration until they are taken.

Both this and the other stale are to be placed in the middle between the two nets, about two or three feet distance from each other; so that in the falling of the nets, the chords may not touch or annoy them: neither must they stand one before or after another; the glass being kept in a continual motion, and the bird very often fluttering. Having placed your nets in this manner, as also your gigs and stales, go to the further end of your long drawing lines and stale lines; and having placed yourself, lay the main drawing line across your thigh, and, with your left, pull the stale line to show the birds; and when you perceive them to play near and about your nets and stales, then pull the net over with both hands, with a quick but not too hasty motion; for otherwise your sport will be spoiled.

Plate CCCLXIX.

See Plate CCCLXIX. where A shows the bodies of the main net, and how they ought to be laid. B, the tail lines, or the hinder lines, staked to the ground. C, the fore lines staked also to the ground. D, the bird stale. E, the looking-glass stale. G, the line which draws the bird stale. H, the line that draws the glass stale. I, the drawing double lines of the nets, which pulls them over. K, the stakes which stake down the four nether points of the nets and the two tail lines. L, the stakes that stake down the fore lines. M, the single line, with the wooden button to pull the net over with. N, the stake that stakes down the single line, and where the man should sit; and O, the gig.

Net, *Neat*, in commerce, something pure, and unadulterated with any foreign mixture.

Thus wines are said to be *net* when not falsified or balderdashed; and coffee, rice, pepper, &c. are *net* when the filth and ordures are separated from them. See NEAT.

A diamond is said to be *net* when it has no stains or flaws; a crystal, when transparent throughout.

NET is also used for what remains after the tare has been taken out of the weight of any merchandise, i. e. when it is weighed clear of all package. See TARE.

Thus we say, a barrel of cochineal weighs 450 pounds; the tare is 50 pounds, and there remain *net* 400 pounds.

Net Produce, a term used to express what any commodity has yielded, all tare and charges deducted.

The merchants sometimes use the Italian words *netto proceduto*, for net produce.

NETHERLANDS, anciently called *Belgia*, but since denominated *Low Countries* or *Netherlands*, from their low situation, are situated between 2° and 7° of east longitude, and between 50° and 53° 30′ of north latitude: and are bounded by the German sea on the north, Germany on the east, by Lorrain and France on the south, and by another part of France and the British seas on the west; extending near 300 miles in length from north to south, and 200 miles in breadth from east to west. They consist of 17 provinces; 10 of which were called the *Austrian and French Netherlands*, and the other seven the *United Provinces*. The whole united were erected into a kingdom at the peace of Paris in 1814.

The greatest part of the Netherlands was conquered by the Romans; and that part which lies towards Gaul continued in their subjection till the decline of that empire; after which the Franks became masters of it; and under the French monarchy, it was part of the kingdom of Metz or Austrasia. Netherlands.

Towards the end of the 15th century Maximilian of Austria, son of the emperor Ferdinand III. acquired, by marrying the only daughter of the duke of Burgundy, the duchies of Brabant, Limburg, and Luxemburg; the counties of Flanders, Burgundy, Hainault, Holland, Zealand, and Namur; and the lordship of Friesland. Philip of Austria, son to Maximilian and Mary, married Jane the daughter of Ferdinand king of Arragon and of Isabella queen of Castile; by which means their son Charles inherited not only almost all Spain and the great countries then lately discovered in America, but also those noble provinces of the Netherlands, and was chosen emperor under the name of *Charles V.* Towards the latter end of the 1527, he added to his dominions the temporalities of the bishoprick of Utrecht on both sides of the Yssel; and Henry of Bavaria, being distressed through war with the duke of Guelderland, and tired with the continued rebellion of his own subjects, surrendered to the emperor the temporalities of his diocese, which was confirmed by the pope, and the states of the country. In 1536, Charles V. bought of Charles of Egmond the reversion of the duchy of Guelderland and of the county of Zutphen, in case that prince should die without issue. The same year the city of Groningen took the oath of allegiance, and submitted to Charles V. and in 1543 he put a garrison into the city of Cambray, and built a citadel there. Having thus united the 17 provinces, as it were in one body, he ordered that they should continue for ever under the same prince, without being ever separated or dismembered; for which purpose he published in November 1549, with the consent and at the request of the states of all the provinces, a perpetual and irrevocable edict or law, by which it was enacted, that in order to keep all those provinces together under one and the same prince, the right of representation, with regard to the succession of a prince or princess, should take place for ever both in a direct and collateral line, notwithstanding the common laws of some provinces to the contrary. Charles had even a mind to incorporate these provinces with the Germanic body, and to make of them a circle of the empire, under the title of the circle of Burgundy, in order thereby to engage the princes of the empire to concern themselves for the preservation of those provinces. But the Netherlands, always jealous of their liberty, did not seem to like that incorporation; and when they were demanded to pay their share towards the expences of the empire, they refused it: whereupon the princes of Germany refused, in their turn, to take any part in the wars in Flanders, and looked upon those provinces as by no means belonging to the Germanic body.

Philip of Austria and his son Charles, who were born in the Netherlands, had for these provinces that natural affection which men use to have for their native country; and, knowing how jealous the inhabitants were of their liberty, and of the privileges granted to them by their former princes, they took great care to preserve them and suffered willingly that the states, who were the guardians of the people's liberty and privileges, should

Netherlands.

should in a manner share the supreme authority with them. Philip II. son to the emperor Charles V. had not the same affection for the Netherlands, nor those generous sentiments which his father had endeavoured to inspire him with. Being born in Spain of a Portuguese woman, he had no regard but for his native country; and, when he removed out of the Netherlands, he left them to the weak government of a woman, to the proud and haughty spirit of Cardinal de Grenville, and to the wild ambition of some lords of these provinces, who availing themselves of the imprudent conduct and continual blunders of the council of Spain, found their private interest in the disturbances they could not fail to produce. Philip II. also, instead of the mild and moderate measures which his predecessors had successfully employed on many occasions, as best suiting the genius and temper of the people, had recourse to the most violent and cruel proceedings; which, far from curing the evil, served only to exasperate it the more and render it incurable. The Spaniards, whom he sent thither, being born and educated in an absolute monarchy, jealous of the liberties and envious of the riches of the people, broke through all their privileges, and used them almost after the same manner as they had done the inhabitants of their new and ill-gotten dominions in America. This treatment occasioned a general insurrection. The counts Hoorn, Egmont, and the prince of Orange, appeared at the head of it, and Luther's reformation gaining ground about the same time in the Netherlands, his disciples joined the malecontents: whereupon King Philip introduced a kind of inquisition in order to suppress them, and many thousands were put to death by that court, besides those that perished by the sword; for these persecutions and encroachments had occasioned a civil war, in which several battles were fought. The counts Hoorn and Egmont were taken and beheaded: but the prince of Orange, retiring into Holland, with the assistance of England and France, preserved Holland and some of the adjacent provinces, which entered into a treaty for their mutual defence at Utrecht in 1579, and they have ever since been styled the *United Provinces;* but the other provinces were reduced to the obedience of Spain by the duke of Alva and other Spanish generals. However, their ancient privileges were in a great measure restored; every province was allowed its great council or parliament, whose concurrence was required to the making of laws, and raising money for the government, though these assemblies were too often obliged to follow the dictates of the court.

The emperor Joseph II. endeavoured to deprive them even of the form of their free constitution; and he might very probably have succeeded, had he not attempted at the same time a reformation of the church. The Austrian Netherlands are wholly Catholic, and so bigotted to the Romish superstition, that though they had tamely submitted to many encroachments of the archducal house on their civil rights, no sooner did the monarch encroach upon the property of the holy mother church than they resisted his authority, and claimed all their ancient privileges political and religious.

The Spaniards continued possessed of almost eight of these provinces, until the duke of Marlborough, general of the allies, gained the memorable victory of Ramillies. After which Brussels the capital, and great part of these provinces, acknowledged Charles VI. (afterwards emperor) their sovereign; and his daughter, the late empress queen, remained possessed of them till the war that followed the death of her father, when the French made an entire conquest of them, except part of the province of Luxemburg; but they were restored by the peace of Aix-la-Chapelle in 1748, and the French retained only Artois, the Cambresis, part of Flanders, part of Hainault, and part of Luxemburg.

Netherlands || Nettings.

These provinces were overrun by the French in 1794, and formally ceded to them by the treaty of Campo Formio in 1797. They kept possession of them till 1814, when they were separated from France, and along with the seven Dutch provinces, formed into a kingdom under the prince of Orange, who assumed the title of king of the Netherlands. By the new constitution promulgated in 1815, the people of the two countries were to be represented in an assembly called the States-General, whose sittings were to be held alternately in a town in Holland and a town in Belgium. The States consist of two chambers; the deliberations of the lower are public, those of the upper private. The constitution guarantees the liberty of the press, the right of petitioning, and the independence of the judges.

The soil is generally fruitful, but differs in the several parts. The climate also differs in the several provinces; in those towards the south it does not differ much from that of England, though the seasons are more regular. In the northern provinces the winter is generally very sharp, and the summer sultry hot; but the extreme cold and excessive heat seldom continue above five or six weeks. The air is reckoned very wholesome, but is subject to thick fogs in winter, through the moistness of the country, which would be very noxious, were it not for the dry easterly winds, which, blowing off a long continent for two or three months in the year, clear the air, and occasion very sharp frosts in January and February; during which, the ports, rivers, and canals are commonly shut up. The face of the country is low and flat; for, except some small hills and a few rising grounds in Utrecht and Guelderland, and in the parts lying towards Germany, there is no hill to be seen in the whole 17 provinces. This is the reason why they have been called the Low Countries. French Flanders abounds in grain, vegetables, flax and cattle, but is in want of wood.

For the *Dutch Netherlands*, see *United Provinces*.

NETHINIMS, among the Jews, the posterity of the Gibeonites, who were condemned by Joshua to be hewers of wood and drawers of water for the house of God.

NETOPION, a name given by the ancients to a very fragrant and costly ointment, consisting of a great number of the finest spicy ingredients. Hippocrates, in his Treatise on the Diseases of Women, frequently prescribes the netopion in diseases of the uterus; and in other places he speaks of its being poured into the ear as a remedy for deafness; these compositions, by their attenuating qualities, dividing the viscous and thick humours. The word *netopion* is also sometimes used to express the *unguentum Egyptiacum*, and sometimes simply for oil of almonds.

NETTINGS, in a ship, a sort of grates made of small ropes seized together with rope yarn or twine, and fixed

Nettings || Neva.

fixed on the quarters and in the tops; they are sometimes stretched upon the ledges from the waste trees to the roof trees, from the top of the forecastle to the poop, and sometimes are laid in the waste of a ship to serve instead of gratings.

NETTLE. See URTICA, BOTANY *Index*.

Sea-NETTLE. See MEDUSA, HELMINTHOLOGY *Index*, and *ANIMAL-Flower*.

NETTLE-Tree. See CELTIS, BOTANY *Index*.

NETTUNO, a handsome town of Italy, in the Campagna di Roma. It is but thinly peopled, though seated in a fertile soil. The inhabitants are almost all hunters. E. Long. 12. 57. N. Lat. 41. 30.

NEVA, a river at Petersburgh, in Russia. The views upon the banks exhibit the grandest and most lively scenes. The river is in most places broader than the Thames at London. It is deep, rapid, and transparent as crystal, and its banks are lined on each side with a continued range of handsome buildings. On the north side the fortress, the academy of sciences and that of art are the most striking objects; on the opposite side are the imperial palace, the admiralty, the mansions of many Russian nobles, and the English line, so called because (a few houses excepted) the whole row is occupied by the English merchants. In front of these buildings, on the south side, is the quay, which stretches for three miles, except where it is interrupted by the admiralty; and the Neva, during the whole of that space, has been lately embanked at the expence of the empress, by a wall, parapet, and pavement of hewn granite; a most elegant and durable monument of imperial magnificence. There is a communication between the opposite sides of the river by a bridge of pontoons, which, when any thing is apprehended from the force of ice rushing down the stream, can be, and is generally indeed, removed. The great depth of the river, it appears, prevents the building of a stone bridge; and, if it could be built, there is no reason to suppose it could possibly resist the force of those vast shoals of ice which in the beginning of winter come down this rapid river. An attempt, however, has been made to remedy this inconvenience; and a Russian peasant has actually projected the plan of throwing a wooden bridge of one arch across it, which, in its narrowest part, is 980 feet in breadth. As we think this is a matter of very considerable importance, as well as of curiosity, we shall give the following copious account of the plan and its author, in Mr Coxe's own words; who tells us that the artist had then executed a model 98 feet in length, which he saw and examined with considerable attention.

"The bridge is upon the same principle with that of Shaffhausen, excepting that the mechanism is more complicated, and that the road is not so level. I shall attempt to describe it by supposing it finished, as that will convey the best idea of the plan. The bridge is roofed at the top, and covered at the sides; it is formed by four frames of timber, two on each side, composed of various beams or trusses, which support the whole machine. The road is not, as is usual, carried over the top of the arch, but is suspended in the middle.

"The following proportions I noted down with the greatest exactness at the time when they were explained to me by the artist.

Length of the abutment on the north end,	658 feet	Neva.
Span of the arch, - -	980	
Length of the abutment on the south end,	658	
Length of the whole structure, including the abutments, - - -	2296	
The plane of the road upon its first ascent makes an angle of five degrees with the ordinary surface of the river.		
Mean level of the river to the top of the bridge in the centre, - -	168	
Ditto to the bottom of the bridge in the centre, - - - -	126	
Height of the bridge from the bottom to the top in the centre, - -	42	
Height from the bottom of the bridge in the centre to the road, - -	7	
Height from the bottom of ditto to the water, - - - -	84	
Height from the water to the spring of the arch, - - - -	56	

So that there is a difference of 35 feet between the road at the spring of the arch and the road at the centre; in other words, an ascent of 35 feet in half 980, or in the space of 490 feet, which is little more than eight-tenths of an inch to a foot. The bridge is broadest towards the sides, and diminishes towards the centre.

In the broadest part it is - -	168 feet.
In the centre or narrowest - -	42
The breadth of the road is - -	28

"The artist informed me, that to complete the bridge would require 49,650 iron nails, 12,908 large trees, 5500 beams to strengthen them: and that it would cost 300,000 rubles or 60,000l. He speaks of this bold project with the usual warmth of genius; and is perfectly convinced that it would be practicable. I must own that I am of the same opinion, though I hazard it with great diffidence. What a noble effect would be produced by a bridge striking across the Neva, with an arch 980 feet wide, and towering 168 feet from the surface of the water! The description of such a bridge seems almost chimerical; and yet upon inspection of the model we become reconciled to the idea. But whether the execution of this stupendous work may be deemed possible or not, the model itself is worthy of attention, and reflects the highest honour on the inventive faculties of that unimproved genius. It is so compactly constructed, and of such uniform solidity, that it has supported 3540 pood, or 127,440 pounds, without having in the least swerved from its direction, which I am told is far more, in proportion to its size, than the bridge if completed would have occasion to sustain from the pressure of the carriages added to its own weight.

"The person who projected this plan is a common Russian peasant. This extraordinary genius was apprentice to a shopkeeper at Nishnei Novogorod: opposite to his dwelling was a wooden clock, which excited his curiosity. By repeated examination he comprehended the internal structure, and without any assistance formed one exactly similar in its proportion and materials. His success in this first essay urged him to undertake the construction of metal clocks and watches.

Neva || Neuchattel.

watches. The empress, hearing of these wonderful exertions of his native genius, took him under her protection, and sent him to England; from whence, on account of the difficulties attending his ignorance of the language, he soon returned to Russia. I saw a repeating watch of his workmanship at the Academy of Sciences: it is about the bigness of an egg; in the inside is represented the tomb of our Saviour, with the stone at the entrance, and the centinels upon duty: suddenly the stone is removed, the centinels fall down, the angels appear, the women enter the sepulchre, and the same chant is heard which is performed on Eastereve. These are trifling, although curious peformances; but the very planning of the bridge was a most sublime conception. This person, whose name is *Kulibin*, bears the appearance of a Russian peasant: he has a long beard, and wears the common dress of the country. He receives a pension from the empress, and is encouraged to follow the bent of his mechanical genius (A).

NEVEL, or NEBEL, in the Jewish antiquities, a kind of musical intrument. See NABLUM.

NEVERS, a town of France, in the department of Nievre, and situated in E. Long. 3. 14. N. Lat. 46. 59. on the river Loire, which here receives the rivulet *Nievre*. It contained 10,150 inhabitants in 1800. It is a place of great antiquity, supposed to be Cæsar's Noviodunum in Æduis, where he erected magazines for his armies. Francis I. made it a duchy and peerage in 1521, in favour of Francis of Cleves, to whom it came by marriage. It devolved afterwards to the house of Mantua, and then to the Palatine family, who in 1651 sold it to Cardinal Mazarine. The cardinal obtained a title of duke and peer for his nephew Philip Mancini, in whose family it continued till the late revolution. The town is fortified with walls, defended with many high towers and deep ditches, and is the seat of a bishopric, suffragan of Sens, as likewise of a bailiwic and chamber of accounts. There was a stone bridge on the Loire, which was carried away by the ice, and has been replaced by a wooden one. This town is famous for its manufacture of glass, earthen ware, cloth, and cutlery. In the centre of Nevers, on the summit of a hill, is built the palace of the ancient dukes. It appears to have been constructed in the sixteenth century, and exhibits a model of the beauty and delicacy of Gothic architecture. The apartments are hung with tapestry of 200 years old, which have an air of grotesque and rude magnificence.

NEUCHATTEL, a town of Swisserland, capital of a county of the same name. There are several ancient ruins near it, which show its former extent; and there are two large churches, besides a castle where the governor resides. The town contains about 3000 inhabitants. It is situated partly on a small plain, between Mount Jura and the lake of Neuchattel, which is 17 miles long and five broad; the side of the harbour is the usual walk of the inhabitants. Part of it too is built upon the side of the mountain; whence some of its streets are very steep. In this small place several public works have lately been executed, which Mr Coxe thinks are far beyond the revenues, or even the wants, of such a little state. Among these he instances a superb causeway and a town-house "built (says he) of such solid materials, as if it was intended to survive to the most distant posterity, and to rival the duration of the much-famed Roman capitol." At the beginning of the 18th century, commerce was very little followed in this town, owing to an absurd opinion which prevailed among the inhabitants, of its being disgraceful; but this prejudice is now extinguished, and the town in a much more flourishing situation than before. The chief article of exportation is wine, which is much esteemed; and manufactures of printed linens and cottons have been established with considerable success. The flourishing state of Neuchattel is principally owing to the benefactions of Mr David Pury, late banker of the court at Lisbon. He was born at Neuchattel in 1709; but having received his education there, he quitted it in great poverty, and repaired to Geneva, where he served his apprenticeship, but in what line is not mentioned. From Geneva he went to London, where he acted as clerk to a dealer in precious stones, and acquired great reputation by estimating the value of diamonds at sight. After a long residence in England he went to Lisbon, where he carried on a very extensive commerce; and having been appointed court-banker, his fortune rapidly increased. His generosity, however, kept pace with his wealth; and he not only remitted large sums to Neuchattel while living, but left his country his heir when he died. His contributions in all are estimated by Mr Coxe at 200,000l.; a considerable part of which has been employed in constructing the public works already mentioned. Neuchattel has a grand and little council: the first is composed of 40 persons, with two masters of the keys; the little council consists of 24 members, comprehending the mayor, who is president. These two councils assemble regularly every month. The ecclesiastics likewise assemble every month, to consult on affairs belonging to the church, and to fill up the places of ministers that die. They choose a dean every year, who is president of the general assemblies, which are called *classes*; and sometimes he is confirmed in this dignity. E. Long. 7. 10. N. Lat. 47. 5.

Neuchattel.

NEUCHATTEL, a sovereign county of Swisserland, bounded on the west by the Franche Compte, on the north by the bishopric of Basle, and on the east and

(A) We have given the detail in Mr Coxe's own words, as it appears to us to deserve attention on account of the greatness of the project, which would have excited admiration had it been attempted by one enlightened by science and liberal arts, much more when it comes through the humble medium of a Russian peasant. It was never executed, as we are just informed by a gentleman who left St Petersburgh about the beginning of June 1793; but the model remains, and is still shown. The same gentleman (we quote his own words) adds, "that every mechanic thinks it practicable; and that the general belief is, that the empress would have built it, had she not found use for all her money in carrying on her warlike and diplomatic transactions with other courts."

Neuchattel || Nevis.

south by the cantons of Berne and Friburg. This principality of Neuchattel and Vallengin extend from the lake of Neuchattel to the borders of Franche Compte, being in length about 12 leagues, and six in breadth. The plain with the lower part of the mountains is occupied by the district of Neuchattel, but Vallengin is totally enclosed by Jura. Parallel chains of these mountains run from east to west, forming several valleys in the most elevated parts. The lower grounds of this chain consist of arable lands and vineyards; the higher of large tracts of forest, which in many parts have been cleared and converted into pasture grounds, intermixed with fields of barley and oats. The inhabitants are numerous, and remarkable for their genius, politeness, and active industry. It contains three cities, one town, 90 villages, and about 300 houses dispersed in the mountains. The inhabitants are all Protestants, except two Roman catholic villages: and in 1529 they entered into a strict alliance with the cantons of Berne, Friburg, Soleure, and Lucern. The air is healthy and temperate, but the soil not everywhere equally fertile: however, there are large vineyards, which produce white and red wine, which last is excellent. The pastures on the mountains feed a great number of cattle; there are plenty of deer in the forests; the lakes and rivers abound with fish. The mildness of the government, and agreeable situation of the inhabitants in general in these districts is evident from the great increase of population in the space of 32 years. In 1752 they contained only 28,017 subjects and 4318 aliens: but in 1784 the number was augmented to 31,576 subjects and 9704 aliens; being an increase of near a fourth part in that time. The facility with which the burghership of Neuchattel is acquired, may also be accounted one of the means of augmenting its population; for between the years 1762 and 1770, the magistrates admitted 41 persons to this privilege; from 1770 to 1780, 46; from 1780 to 1785, 51; in all 138; many of whom had children before they purchased their burghership, and 38 of them were foreigners, either German, French, or Dutch. This country has experienced similar changes with the rest of Switzerland during the usurpation of the French.

NEUFCHATTEAU, a commercial town of France, in the department of the Vosges, containing 2700 inhabitants. It formerly had an abbey of the nuns of St Clair, a commandery of Malta, and several convents of monks and nuns. It is seated in a fertile soil, which produces corn, wine, and all the necessaries of life, on the river Mouzon. E. Long. 5. 45. N. Lat. 48. 20.

NEVIS, one of the Caribbee islands, lying about seven leagues north of Montserrat, and separated from St Christopher's by a narrow channel. It makes a beautiful appearance from the sea, being a large conical mountain covered with fine trees, of an easy ascent on every side, and entirely cultivated. The circumference is about 21 miles, with a considerable tract of level ground all around. The climate in the lower part is reckoned to be warmer than Barbadoes, but it is more temperate towards the summit. The soil is very fine in the lower part, but grows coarser as we ascend. The productions are nearly the same with those of St Christopher's. There are three pretty good roads or bays, with small towns in their vicinity; Charles Town, Moreton bay, and Newcastle. This pleasant island was settled under the auspices of Sir Thomas Warner from St Christopher's. His successor, Governor Lake, was considered as the Solon of this little country, in which he disposed of every thing with such prudence, wisdom, and justice, as procured him a high reputation with the French as well as English. In the Dutch war they met with some disturbance from the French; but by being covered by an English squadron, the enemy were obliged to desist from their intended invasion, after a smart engagement in sight of the island. Sir William Stapleton sometimes resided here, and Sir Nathaniel Johnson constantly, at which time the inhabitants of Nevis were computed at 30,000. In the war immediately after the Revolution, they exerted themselves gallantly, and had two regiments of 300 men each. In that of Queen Anne they behaved equally well, though they were less fortunate; for the French landing with a superior force, and having inveigled most of their slaves, they were forced to capitulate. About 4000 of these slaves the French carried away and sold to the Spaniards, to work in their mines. The parliament, after making due inquiry into the losses they had sustained, voted them about a third part of the sum in which they had suffered. These losses by war, an epidemic disease, and repeated hurricanes, exceedingly diminished the number of the people. They are now thought not to exceed 2000 or 3000 whites, and 6000 blacks. There is here a lieutenant governor, with a council, and an assembly, which is composed of three members from each of the five parishes into which the island is divided. The commodities are cotton and sugar; and about 20 sail of ships are annually employed in this trade.

Nevis || Neuter.

NEURADA, in *Botany*, a genus of plants belonging to the decandria class, and in the natural method ranking under the 13th order, *Succulentæ*. See BOTANY *Index*.

NEUROGRAPHY, signifies a description of the nerves. See ANATOMY.

NEUROPTERA, the name of one of the orders into which the class of insects is divided according to the Linnæan classification. See ENTOMOLOGY *Index*.

NEUTER, a person indifferent, who has espoused neither party, and is neither friend nor foe.

A judge ought to be neuter in the causes he judges; in questions, where reason appears neuter, a man should ever incline to the side of the unhappy.

NEUTER, in *Grammar*, denotes a sort of gender of nouns, which are neither masculine nor feminine. See GENDER.

The Latins have three kinds of genders, masculine, feminine, and neuter. In English, and other modern tongues, there is no such thing as neuter nouns. See NOUN.

Verbs NEUTER, by some grammarians called *intransitive verbs*, are those which govern nothing, and that are neither active nor passive. See VERB.

When the action expressed by the verb has no object to fall upon, but the verb alone supplies the whole idea of the action; the verb is said to be *neuter*: as, I sleep, thou yawnest, he sneezes, we walk, ye run, they stand still.

Some divide verbs neuter into, 1. Such as do not signify any action, but a quality; as *albet*, "it is white;"

or

Neuter ‖ Newark.

or a situation, as *sedet*, "he sits;" or have some relation to place; as *adest*, "he is present;" or to some other state or attribute, as *regnat*, "he rules," &c. And, 2. Those that do signify actions, though those such as do not pass into any subject different from the actor; as to dine, to sup, to play, &c.

But this latter kind sometimes cease to be *neuter*, and commence active; especially in Greek and Latin, when a subject is given them; as, *vivere vitam*, *ambulare viam*, *pugnare pugnam*. Thus the old French poets say, *Soupirer son tourment*; the English, to *sigh his woes*, &c.

But this is observed only to obtain where something particular is to be expressed, not contained in the verb: as, *vivere vitam beatam*, to live a happy life; *pugnare bonam pugnam*, to fight a good fight, &c.

According to the abbot de Dangeau, *verbs neuter* may be divided into *active* and *passive*; the first, those that form their tenses in English, by the auxiliary verb *to have*; in French, by *avoir*. The second, those that form them in English with the verb *to be*; in French *être*.—Thus, to sleep, to yawn, *dormir* and *eternuer*, are *neuters active*.—To come, and to arrive, are *neuters passive*.

Neutral Salts, in *Chemistry*, compounded of an acid with any other substance capable of uniting with it and destroying its acidity, as sulphuric acid and soda, or Glauber's salt, muriatic acid and soda, or common salt.

NEUTRALITY, the state of a person or thing that is neuter, or that takes part with neither side.

NEW-ABBEY, situated near Kilcullen bridge in the county of Kildare, and province of Leinster in Ireland. It was founded by Rowland Eustace, of a great and ancient family in this county; the tower is still standing, and some part of the abbey; the ruins of the rest have contributed to build several dwellings near it. In the inside Rowland Eustace and his lady lie buried; their figures, clothed in armour, are to be seen there. Near this is a handsome seat of the Carter family, on the opposite side of the river Liffey.

NEWARK *upon Trent*, in the county of Nottingham, is a great thoroughfare in the York road, 124 miles from London. It has bridges over the Trent, which forms an island here, by dividing itself into two streams two miles above the town, which meet again two miles below it. A magnificent castle was built here in the reign of King Stephen, which held out stoutly in the barons wars for King John, who died here, October 19. 1216; and it also stood out for King Charles I. to the last; but after he had put himself into the hands of the Scots army then before it, the governor by his order surrendered it, after which it was demolished.—It was situated near the river; the walls of the towers are very thick, and of a very great height; and were there no historical testimony, these remains are sufficient evidence that it was formerly of great importance. In the court before these ruins is a very fine bowling green. The town being subject to inundations from the river Trent, and often from that circumstance made impassable, a turnpike road, at the instigation of a publican, was made about twenty years ago, so high as to be passed with safety in the greatest floods, by arches of brick being made in several places to carry off the water, constructed by Mr Smeaton, at the expence of 12,000l. Near the town there is a bridge constructed for the same purpose, made mostly upon dry land, consisting of nine arches. Its church, which is reckoned one of the finest in the kingdom, was built by Henry VI. and has a lofty spire. The population in 1811 was 7236.

Newark ‖ Newcastle on Tyne.

NEWBOROUGH, or Newburgh, in the isle of Anglesey, North Wales, distant from London 254 miles, though but a small town, situated over against Caernarvon in North Wales, about 17 miles south-west from Beaumaris, is governed by a mayor, two bailiffs and a recorder. Its Welsh name is *Rhôssir*, or *Rhosvair*.

NEWBURG, the name of several towns of Germany, two of which are the chief towns of duchies of the same name; one in Bavaria, and the other in the Palatinate.

NEWBURY, a town in the county of Berks in England, 16 miles from Reading, and 56 from London, arose on the decay of Spinham-Land. Notwithstanding its name signifies *New-Borough*, it is as old almost as the Conquest. It made so much broad cloth formerly, that in the reign of Henry VIII. here flourished John Winscomb, commonly called *Jack of Newbury*, one of the greatest clothiers that ever was in England, who kept 100 looms in his house; and in the expedition to Flowden Field against the Scots, marched with 100 of his own men, all armed and clothed at his own expence; and he built all the west part of the church. Also Mr Kenric, the son of a clothier here, though afterwards a merchant in London, left 4000l. to the town, as well as 7500l. to Reading, to encourage the woollen manufactory. It makes a great quantity of shalloons and druggets, but not near so much broad cloth now as formerly; yet it is a flourishing town, with spacious streets, and a large market place, in which is the guild-hall. In the neighbourhood, on the banks of the Kennet, there is a stratum of petrified wood dug out for firing, where they frequently find trunks of large oaks yet undecayed, with petrified hazel nuts, fir cones, &c. with the bones and horns of stags, antelopes, &c. tusks of boars, and heads of beavers. The river Kennet, which abounds with excellent trout, eels, and cray-fish, runs through the town. It was made a corporation by Queen Elizabeth, and is governed by a mayor, high steward, aldermen, &c. The population in 1811 was 4898.

NEWCASTLE-*under-Line*, a town in England, in the county of Stafford, on a branch of the Trent, is 15 miles north of Stafford, 33 south south-east of Warrington, and 149 from London: had a castle, now in ruins; and is so called from an older castle, which formerly stood two miles off, at Chesterton-under-Line. It was incorporated by King Henry I. and again by Queen Elizabeth and King Charles II. and is governed by a mayor, two justices, two bailiffs, and 24 common council. The population in 1811 was 6175. The clothing trade flourishes here; but its chief manufactory is hats, here being an incorporated company of felt-makers. A great quantity of stone ware is made near this place.

Newcastle *on Tyne*, the capital of the county of Northumberland in England, 15 miles north of Durham, 94 north of York, 63 south by east of Berwick, 60 east of Carlisle, and 271 from London, stands at the end of the Picts wall, on the north side of the Tyne,

over

Newcastle on Tyne.

over which it has a stately bridge into the bishopric of Durham, in which its suburb called *Gateside* is situated; for the liberties of Newcastle extend no farther than the great iron gate upon the bridge, which has the arms of the bishop of Durham carved on the east side and those of Newcastle on the west side. W. Long. 1. 27. N. Lat. 55. 5. It is admitted to have been a Roman station, though no evidence at present appears, except at Pandon-gate, whose superstructure is of different workmanship and model from any others of the town, the arches being circular. The Carpenter's tower is also of Roman original. In the Saxons time it was called *Moncaster*, from the monks here, who all fled when it was depopulated by the Danes; and afterwards *Newcastle*, from a castle built here by William the Conqueror's son, Robert, in 1080, to defend the country against the Scots, whose kings had this town before the Norman conquest, and sometimes resided here. —Several monasteries and houses were built here soon after the castle; and it was greatly enlarged and enriched by a good trade to the coasts of Germany, and by the sale of its coal to other parts of England; for which, and for other merchandise, it is become the great emporium of the north of England, it being the neatest and largest town in those parts, next to York. In the reign of Edward I. it was burnt by the Scots; but a very rich burgher, who was taken prisoner, soon ransomed himself for a good sum of money, and began the first fortifications of the place, which he extended from Sandgate to Pampedon, and thence to the Austin friars gate; which the townsmen finished, and encompassed with stout walls, which extended two miles, wherein are seven gates and many turrets, with several casemates bomb-proof. To which two other gates were added in more modern times, viz. Bridge-gate and Sand-gate: the wall between them was afterwards removed to open the quay. Edward III. granted the corporation the duties and customs of the town for seven years, to enable them to complete the fortification. It is a borough at least as ancient as King Richard II. who granted that a sword should be carried before the mayor; and King Henry VI. made it a town and county incorporate of itself, independent of Northumberland. Henry VII. built a monastery here for the Franciscans. Besides which, it had several religious foundations, several of which structures have been converted to companies halls and private residences. In the reign of Henry VIII. this place is said to have exceeded in the strength and magnificence of its works all the cities of England, and most places in Europe. The town is governed by a mayor, 12 aldermen, a recorder, sheriff, town clerk, a clerk of the chambers, two coroners, eight chamberlains, a sword-bearer, a water bailiff, and seven serjeants at mace. Its situation, especially the most busy part of it towards the river, is very uneven, it being built on the declivity of a steep hill, and the houses very close. The castle overlooks the whole town. That part built by Robert was of great strength, and square, and surrounded by two walls; the square was 62 feet by 54, and the walls 13 feet thick, within which was a chapel. The outward fortifications are now defaced, and their site crowded with buildings. The tower remains entire, and situated on a lofty eminence, and its principal entrance is to the south. This castle belongs to the county, and makes no part of the liberties.—It is now the county prison, and in the great hall the judges hold the assizes. Here Baliol king of Scotland did homage to King Edward I. in 1292: as did Edward Baliol in 1334 to King Edward III. Here is a magnificent exchange and a customhouse; and a very fine quay. There is a handsome mansion house for the mayor, who is allowed 1000l. a-year, for his table, besides a coach and barge. The old bridge was carried away in a flood, and the present was erected about 1775, of nine noble elliptic arches. With the old bridge 22 houses were thrown down, and six lives lost. It was originally built of wood; but having been destroyed by fire in 1248, was rebuilt of stone, and consisted of 12 arches, three of which on the north side were closed up, and served for cellars: this was again rebuilt about 1450, and was crowded with wooden buildings; but near the middle was a tower with an iron gate, used as a town prison. A strong building crossed the bridge, which was used as a magazine. On the south front was a statue of King Charles II. The water which destroyed this bridge, on November 11. 1771, was upwards of 12 feet above high water mark in spring tides.—On removing the foundations of the piers of the old bridge to erect the present, by observations made, and medals found, part of it is supposed to have existed from the time of the Romans. It is computed that above 6000 keelmen are employed here, who have formed themselves into a friendly society; and by their own contributions, built a noble hospital containing 50 chambers, for such of their fraternity as are poor, disabled, or past their labour; and it is supported by the contribution of those that are in health. The town is extremely populous; and, notwithstanding the multitude of those employed in and about the coal pits, with which the town is in a manner surrounded, has abundance of poor; but it has also many wealthy inhabitants, and it is said they pay above 4000l. a-year to their relief. It is observed, that this town has the greatest public revenue in its own right as a corporation, of any town in England, it being computed at no less than 8000l. a-year. In 1774, the receipts of the corporation were 20,360l. 9s. 8d.; and their disbursements about 19,445l. The number of inhabitants in 1811 was 27,587, exclusive of a number of seamen who cannot be accurately estimated. Here are four churches or chapels. That of St Nicholas is the mother church, a curious fabric, built cathedral-wise by David king of Scots, 240 feet long, 75 broad, and proportionably high, with a tower steeple 194 feet in height, of Gothic architecture; also St Andrew's, St John's, and All Saints, lately rebuilt on the site of the old structure, of a circular form. Here are also several meeting houses, and four charity schools for 300 children; a fine hall for the surgeons, and a large prison called *Newgate*; also an hospital for lunatics, another for the lying-in of married women, as well as a fund raised for the relief of those who are delivered at their own houses. Here is a well endowed and large infirmary, and an assembly room that attracts attention, containing every useful apartment, and a ball room 93 feet by 40: The front is ornamented with six Ionic pillars, &c. In another part of the town is a new theatre. Here is a very neat set of baths. A free grammar school was granted by James I. from an old foundation

Newcastle on Tyne.

of St Mary's hospital, in the vestry room of whose chapel is the election of the officers of the corporation. There were formerly several palaces in this city, viz. Pampedon hall, Lumley place, Earl's Place, Northumberland house, Westmoreland place, &c. The free masons have lately erected an elegant hall, richly ornamented, to hold their lodge in, near High friar chair, capable of holding above 4000 of that ancient fraternity. Here is an hospital for 39 decayed freemen and their widows; and another for three clergymen's widows and three merchants widows. The Maidens hospital, built in 1753, is endowed with 2400l. for six maiden women and six poor men. Dr Thomlin, a prebendary of St Paul's, and rector of Whicham in the bishopric of Durham, gave a library of above 6000 valuable books to the corporation, and settled a rent charge of 5l. a-year for ever for buying new ones; and Sir Walter Blacket, formerly one of its representatives in parliament, built a neat repository for them, and settled 25l. a-year for ever on a librarian. The upper or north part of the town, inhabited by the politer sort of people, is much pleasanter than that part next the river, and has three level, well built, and spacious streets. The river all the way up from Shields to Newcastle is broad, the channel safe, and the tide flows with a strong current to the town, and far beyond it. In the beginning of the civil wars, this town was taken and plundered by the *Scotch fanatics*, who here sold their king, Charles I. for 200,000l. in hand, and security for as much more. The glass works are very curious, and have more business of the fine sort than most other places: the duty on this article drawn by government is said to amount to 200,000l. annually. Besides, it has a considerable manufacture of broad and narrow cloths, and several soap boileries; and this place is famous for grindstones, for which there is such a demand, that scarce a ship stirs without them; from whence came the proverb, "That a Scotsman and a Newcastle grindstone travel all the world over." Ships fit for the coal trade are built here to perfection, with great strength. Here is a considerable manufactory of hardware and wrought iron, after the manner of that at Sheffield.—Its markets are on Tuesdays and Saturdays. Its fairs in August, which last nine days, and October 29th, which last nine days. By an act of Queen Mary, the price of the carriage of goods hither from London by waggons was settled at 2d. per lib. London alone is said to consume at least 766,887 chaldrons of its coal every year; but as for the fish vended in that city by the name of *Newcastle salmon*, it is more properly called *Berwick salmon*, the fresh salmon being taken near 50 miles farther, as far as the Tweed, and brought on the backs of horses to Shields, where it is cured, pickled, and sent on board for London. It is worth remembering, that at the assizes here in 1743, two old men were subpœna'd hither as witnesses from a neighbouring village, viz. one 135 years of age, and his son 95, both hearty, and having their sight and hearing; and that in 1744, one Adam Turnbull died in this town aged 112, who had had four wives, the last of whom he had married when he was near 100 years old.

The annual amount of the revenue of customs at this port, which Mr Brand in his History of Newcastle states at 41,000l. is now very considerably upwards of 70,000l.

Newcastle on Tyne, Newcastle.

The coals carried out of it annually (on an average from 1785 to 1791) were nearly 448,000 Newcastle chaldrons; the weight of which is 1,187,200 tons. The following are the exports of coals from the Tyne for the years annexed.

Years.	Coastways.	Over sea.	Plantations.
1802	494,488	41,157	2844
1803	505,137	42,808	1516
1804	579,929	48,737	3852
1805	552,827	47,213	2360

The number of persons employed in the coal trade of the rivers Tyne and Wear in 1792 exceeded 64,000.

The manufacture of earthen ware is greatly increased, and carried on to great perfection in its neighbourhood, in seven potteries; and their produce exported hence to foreign parts, as well as to the different ports of this kingdom; some of which potteries constantly employ upwards of 100 persons, men, women, and children.

New works of considerable extent for the manufacture of iron have been established; as also a very capital manufactory for white lead, milled lead, &c. Independent of red and white lead, the quantity of lead exported from the river Tyne during four years was as follows.

Years.	Tons.	Cwt.
1802	8609	18
1803	6364	6
1804	10352	2
1805	9163	3

The trade with the West India islands is increasing, and may in time become very considerable; as the port has great advantages, in being able to supply on the cheapest terms many articles wanted in those islands; such as coals, grindstones, lime, bricks, tiles, iron wares, &c.; and is most advantageously situated for the re-exportation of the West India produce to the ports on the Baltic, to Germany, the United Provinces, Flanders, and part of France; and moreover, the risk of navigation, and the rate of insurance, not being greater than between those islands and Liverpool, and some other ports on the western coast of this kingdom.

The population of Newcastle in 1811 was 27,587, and it is daily increasing in inhabitants and opulence. It has long been noted for hospitality and good living. Great improvements have been made in the town, by opening new streets, and paving the principal ones, in the same manner as in London. To the list of public edifices of modern erection, and mentioned above, viz. the grand assembly rooms, and the elegant theatre, which were built by subscription, and the superb parish church of All Saints, built at a very great expence by the parishioners, may be added a commodious riding house, built also by subscription.

NEWCASTLE, a borough town of Ireland, in the county of Dublin, and province of Leinster, which formerly returned two members to parliament, and holds two fairs, 9th of May and 8th of October.

NEWCASTLE is also the name of a handsome town in

Newcastle || New Forest.

in the county of Limerick and province of Munster, on the high road to Kerry, 114 miles from Dublin. Here was a religious house possessed by the knights templars. It is said, they used some barbarous customs which greatly disgusted the Irish, who, watching a favourable opportunity, attacked a number of the knights riding out together and put them to death; the place is still remembered where their remains were interred. This order was suppressed in the famous council of Vienna, 22d of March 1312. Newcastle consists of a large square where markets and fairs are held; on the northern side stands a market house, with an assembly room; on the south side is the church, which is the neatest in the county: it was finished in 1777 at the sole expence of Lord Courtenay. It stands close to the walls and fortifications of the knights templars, of which one of the castles is fitted up for Lord Courtenay's agent.

NEWCASTLE, a town in America, 35 miles below Philadelphia, on the west bank of Delaware river. It was first settled by the Swedes about the year 1627, and called *Stockholm*. It was afterwards taken by the Dutch, and called *New Amsterdam*. When it fell into the hands of the English, it was called by its present name. It contained 2438 inhabitants in 1800, including 235 slaves, and was formerly the seat of government. This is the first town that was settled on Delaware river.

NEWCASTLE, *Duke of*. See CAVENDISH.

NEW England. See *ENGLAND, New*.

NEW Forest of Hampshire in England, is a tract of at least 40 miles in compass, which had many populous towns and villages, and 36 mother churches, till it was destroyed and turned into a forest by William the Conqueror. There are nine walks in it; and to every one a keeper, under a lord warden, besides two rangers, and a bow-bearer. As this large tract lay many ages open and exposed to invasions from foreigners, King Henry VIII. built some castles in it: and it has now several pretty towns and villages. It is situated in that part of Hampshire which is bounded on the east by Southampton river, and on the south by the British channel. It possesses advantages of situation, with respect to the convenience of water carriage and nearness to the dock yards, superior to every other forest, having in its neighbourhood several ports and places of shelter for shipping timber, among which Lymington is at the distance of only two miles, Bewley about half a mile, and Redbridge three or four miles from the forest; and the navigation to Portsmouth, the most considerable dock yard in this kingdom, is only about 30 miles from the nearest of those places. This is the only forest belonging to the crown of which the origin is known. Doomsday-book contains the most distinct account of its afforestation by William the Conqueror: the contents of every field, farm, or estate afforested, in hides, carucates, or virgates, by which the extent of land was then computed, together with the names of the hundreds and villages, and of the former proprietors (which are for the most part Saxon), the rent or yearly value of each possession, and the tax which had been paid for it to the crown during the reign of Edward the Confessor, before the inhabitants were expelled, and that part of the country laid waste, are all to be found in that most curious and venerable record. Wishing to discover the original extent of the forest, we extracted, for our own information, all that relates to it in that ancient survey. The extract is far too voluminous for insertion. The names of many of the places having been changed since that time, it is difficult to ascertain with precision what were then the limits of the forest. The oldest perambulation we have met with is among the Pleas of the Forest, in the eighth year of King Edward I. preserved in the Chapter-house at Westminster. The boundaries there described include all the country from Southampton river on the east to the Avon on the west, following the sea coast as far as the southern boundary between those rivers, and extending northwards as far as North Chadeford, or North Charford, on the west, and to Wade and Orebrugg, or Owerbridge, on the east; and the greatest part, if not the whole, of that extensive district, is mentioned in Doomsday book to be the forest belonging to the crown. Another perambulation was however made in the 29th of the same king, which leaves out a great part of the country contained within the former. This perambulation, which is preserved in the Tower of London, confines the forest to limits which, as far as we can trace them, appear to have been followed in the 22d year of Charles II. when the forest was again perambulated. By the *Charta de Foresta*, all lands not belonging to the crown which had been afforested by Henry II. Richard I. or King John, were to be disafforested; but as no provision was made for the reduction of the more ancient afforestations, it is easy to account for the great diminution of this forest in the reign of Edward I. who was not a prince likely to submit to any encroachment on his rights. The perambulation of the 22d of Charles II. is the last which we find on record: it contains the present legal bounds of the forest, and was given to the surveyors as their guide, in taking the plan which they have made lately by direction. From that plan, with the approbation of the lords commissioners of his majesty's treasury, an engraving was made. According to the last-mentioned perambulation and the plan, the forest extends from Godshill on the north-west to the sea on the south-east, about 20 miles; and from Hardley on the east to Ringwood on the west, about 15 miles; and contains within those limits about 92,365 acres statute measure. The whole of that quantity, however, is not forest land, or now the property of the crown: there are several manors and other considerable freehold estates within the perambulation, belonging to individuals, to the amount of about 24,797 acres; about 625 acres are copyhold or customary lands belonging to his majesty's manor of Lyndhurst; about 1004 acres are lease-hold under the crown, granted for certain terms of years, and forming part of the demised land revenue, under the management of the surveyor-general of crown lands; about 901 acres are purprestures or encroachments on the forest; about 1193 acres more are enclosed lands held by the master-keepers and groom-keepers, with their respective lodges; and the remainder, being about 63,845 acres, are woods and waste lands of the forest. To perpetuate the spot where William Rufus was killed by the glance of an arrow shot at a stag, a triangular stone was erected in 1745. George III. visited

New Forest.

New Forest || Newfoundland.

sited this spot in 1789. In August 1782, a curious ancient golden cross was found here by a labouring man digging turf. It weighed above an ounce of gold, and had on one side an engraving of our Saviour, and on the other, the ladder, spear, nails, and other emblems of his sufferings.

New Holland. See *Holland, New*,

New York. See *York, New*.

New Zealand. See *Zealand, New*.

New Years Gifts, presents made on the first day of the new year. Nonius Marcellus refers the origin of this custom among the Romans to Tatius king of the Sabines, who reigned at Rome conjointly with Romulus, and who having considered as a good omen a present of some branches cut in a wood consecrated to *Strenia*, the goddess of strength, which he received on the first day of the new year, authorized this custom afterwards, and gave to these presents the name of *strenæ*. However this may be, the Romans on that day celebrated a festival in honour of Janus, and paid their respects at the same time to Juno; but they did not pass it in idleness, lest they should become indolent during the rest of the year. They sent presents to one another of figs, dates, honey, &c. to show their friends that they wished for a happy and agreeable life. Clients, that is to say, those who were under the protection of the great, carried presents of this kind to their patrons, adding to them a small piece of silver. Under Augustus, the senate, the knights, and the people, presented such gifts to him, and in his absence deposited them in the capitol. Of the succeeding princes some adopted this custom and others abolished it; but it always continued among the people. The early Christians condemned it, because it appeared to be a relick of Paganism and a species of superstition; but when it began to have no other object than that of being a mark of veneration and esteem, the church ceased to disapprove it.

NEWEL, in architecture, is the upright post which a pair of winding stairs turn about; this is properly a cylinder of stone, which bears on the ground, and is formed by the end of the steps of the winding stairs.

NEWFIDLER-SEA, a lake in Hungary, 17 miles in length and 6 in breadth.

NEWFOUNDLAND, a large island of North America, belonging to Great Britain, lying between 46. 50. and 51. 30. N. Lat. and between 53. 30. and 58. 20. W. Long. from London. The form is that of an irregular triangle, the base or south side being 80 leagues in extent; the east side is the longest; and the whole circumference about 150 leagues. It is bounded on the north by the straits of Belleisle, which separate it from Labrador; on the east and south it hath the Atlantic ocean, and on the west the gulf of St Lawrence. The climate is rather severe; and the soil, at least on the sea coast, which is all that we know of it, is poor and barren. A few kitchen vegetables, with strawberries and raspberries, are all its produce. The country within land is mountainous, and abounds with timber; there are several rivers which are plentifully stored with various sorts of fish, abundance of deep bays, and many good ports. St John's and Placentia are the two principal settlements, and at each of these there is a fort; the number of people who remain here in the winter hath been computed at 4000. The French, by the treaty of Utrecht, were permitted to fish from Cape Bonavista on the east side round the north of the island to Point Rich on the west; and by the treaty of Paris, they are allowed the isles of St Pierre and Miquelon, upon which they are to dry their fish, but not to erect fortifications of any kind. Newfoundland.

The great importance of this place arises from its fishery, which is in part carried on by the inhabitants at the several harbours, which are about 20 in number, who take vast quantities of cod near the coast, which they bring in and cure at their leisure, in order to have it ready for the ships when they arrive. But the great and extensive fishery is on the banks at some distance from the island. The great bank lies 20 leagues from the nearest point of land, from the latitude 41° to 49°, stretching 300 miles in length and 75 in breadth.—To the east of this lies the False Bank; the next is styled *Vert*, or *the Green Bank*, about 240 miles long, and 120 over; then Banquero, about the same size; the shoals of Sand Island, Whale Bank, and the Bank of St Peter's, with several others of less note, all abounding with fish.

The cod are caught only by a hook; an expert fisher will take from 150 to 300 and upwards in a day; for the fish never bite in the night: the labour is very great. The season is from May to October, in the height of which there are from 500 to 700 sail upon the banks at a time. The fish caught in the spring months are best; they are cured in very different ways. Some are styled *white fish*, others *mud fish*, which are stowed and salted in the hold, and will not keep long; but the best and most valuable are the dried cod. The quantity taken is prodigious: yet in some seasons and in different places varies considerably, as the fish frequently change their stations. The *fishing ships*, as they are called, lie upon the banks, with the help of their boats take and cure their own fish, and as soon as they are full sail for a market. The sack ships proceed directly to the island, where they purchase fish from the inhabitants either by barter or bills of exchange. The principal markets for cod are Spain, Portugal, Italy, and the West Indies. The value of this fishery is computed at some hundred thousand pounds annually; employing, besides several hundred ships, some thousands of seamen, and affording a maintenance to a number of tradesmen of different occupations, by which many large towns on the west side of England accumulate much wealth, and at the same time contribute in many respects to the benefit of the public.

The great utility of this fishery was very early seen, and very vigorously pursued; for in the beginning of the reign of King James I. we had two hundred and fifty sail employed therein. It is computed, that three quintals of wet fish make one quintal of dried cod. Besides, the livers of every hundred quintals make a hogshead of oil; and exclusive of these there are many lesser advantages that go in diminution of the expence. The fishery, as we have said above, produces differently in different seasons; but it is judged to be a very good one when it produces 300,000 quintals of fish and 3000 barrels of oil, both equally saleable and valuable commodities. As every ship carries twelve, and each of their boats eight men, and as these return home in six months, there cannot be a more noble nursery for

Newfoundland. seamen. The artificers and traders employed in building, victualling, and repairing these vessels, are very numerous in the respective ports from which they sail. These circumstances justify the particular attention paid by government to this branch of the public service; in respect to which that they may be well informed, an annual and very distinct account, by which the whole is seen at one view, is delivered by the proper officer to the governor of Newfoundland, that is, to the commodore of his majesty's squadron. Mr Pennant, in the appendix to his Arctic Zoology, gives us, from what appears to be very good authority, the following account of this island.

"Within the circuit of 60 miles of the southern part, the country is hilly, but not mountainous. The hills increase in height as they recede from the sea; their course is irregular, not forming a chain of hills, but rising and falling abruptly. The coasts are high, and the shores most remarkably bold. The same may be said of almost every part of this vast island. The country is much wooded, and the hills (such as have not flat tops to admit the rain to stagnate on them) are clothed with birch, with hazel, spruce, fir, and pine, all small; which is chiefly owing to the inhabitants taking off the bark to cover the fish stages. This peninsula is so indented by the fine and deep bays of Placentia, St Mary, Conception, and Trinity, that it may be penetrated in all parts, which is done for the sake of fowling, or the procuring of spars for masts, oars, &c. The island is on all sides pierced with deep bays, which peninsulate it in many places by isthmuses most remarkably narrow.—The mountains on the south-west side, near the sea, are very high, and terminate in lofty headlands; such are Chapeau Rouge, a most remarkably high promontory, Cape St Mary's, and Cape le Hune. Such in general is the formation of the island; on the north-east, most of the hills in the interior part of the country terminate pyramidically, but form no chain. The interior parts of the country consist chiefly of morasses, or dry barren hummocks, or level land, with frequent lakes or ponds, and in some places covered with stunted black spruce. The rivers of Newfoundland are unfit for navigation, but they are of use in floating down the wood with the summer floods. Still the rivers and the brooks are excellent guides for the hunters of beavers and other animals, to penetrate up the country, which as yet has never been done deeper than 30 miles. Near the brooks it is that timber is commonly met with, but seldom above three or four miles inland, and in valleys; the hills in the northern district being naked and barren.

"In some parts of Newfoundland there is timber sufficiently large for the building of merchant ships: the hulk is made of juniper, and the pine furnishes masts and yards; but as yet none has been found large enough for a mast for a large cutter. The fishery is divided into two seasons; that on the shore, or the shore season, commences about the 20th of April, and ends about the 10th of October; the boats fish in from four to 20 fathoms of water. The most important, the bank fishing season, begins the 10th of May, and continues till the last of September, and is carried on in 30 to 45 fathoms deep of water. Banking vessels have sailed from St John's to the bank as early as the 12th of April. At first they use pork or birds for a bait; but as they catch fish, they supply themselves with a shell fish called clams, which is found in the belly of the cod. The next bait is the lobster; after that the herring and the launce, which last till June, when the capelan comes on the coast, and is another bait. In August the squid comes into use, and finally the herring again. The greatest number of cod fish taken by a single fisherman in the season has been 12,000, but the average is 7000. The largest fish which has been taken was four feet three inches long, and weighed 46 pounds. A banking vessel of 10,000 fish ought to be filled in three weeks, and so in proportion; and 80 quintals (112lb. each) for a boat in the same time. Newfoundland || Newross.

"In 1785, 541 English vessels fished on the bank, a number exceeding that of the French. A heap of dried fish, 20 feet long and ten wide, and four deep, contains 300 quintals. Such a heap settles, in the course of 48 hours after it is made, about $\frac{1}{3}\frac{1}{2}$. An extraordinary splitter will split five quintals of fish in an hour. The average in that time is two. There is no fishing during winter, on account of the inclemency of the season. It is supposed that the fish in a great measure quit the banks before that time, as in general they are very scarce when the fishing vessels go upon the banks early in the spring.

"There are a few small towns on the coasts, which have gardens sown with English pulse; but many of the inhabitants quit the country in winter.

"An admiral or some sea officer is generally governor of Newfoundland."

NEWMARKET, in Cambridgeshire, 13 miles from Cambridge, 13 from St Edmundsbury, and 60 from London, is a town with one long street, the north side in Suffolk, the south side in Cambridgeshire. It is a healthy place, and a great thoroughfare in the road from London to Norfolk; but stands mostly by the horse races every year in April and October, here being the finest course in England; on which there is a house for the king when he comes to the races, which was built by Charles II. The king gives a plate or two every year, besides those given by the nobility; and wagers are laid upon the horses, which are seldom under 500l. and often above 1000l. Here are two coffeehouses, at which, every night and morning during the races, there is gaming, as there is also at the houses of the nobility and gentry. Here are also cock matches. Here is a little chapel, which is a chapel of ease to the mother church at Ditton; and another in the Suffolk side, which is parochial. The town was burnt in 1683, but soon rebuilt; and in 1811 contained 1917 inhabitants.

NEWROSS, a borough town in the county of Wexford, and province of Leinster in Ireland, 67 miles from Dublin. This town was formerly walled, and some of the gates still remain. It lies on the river Barrow, which is here very deep, and ships of burden can come up to the quay even when the tide is out. The church is large, but the customhouse and quay are both small, and sometimes overflooded many feet, It is one of the staple ports for exporting wool, yet its trade is but inconsiderable; beef and butter are the principal articles exported. Here is a barrack for a troop of horse, and a good ferry into the county of Kilkenny. Near this town is a charter school. It is also a post town, and gives title of earl to the family of Core. It was formerly fortified, and adorned with

Newross || Newton.

with many religious houses, among which was a Crouched friary, built on the summit of a hill in the town; but one of the friars having killed a principal inhabitant, the whole body of the people arose, put the friars to death, and totally destroyed the friary; on the site of which the monastery of St Saviour, for conventual Franciscans, was afterwards erected by Sir John Devereux; and the east end of this last building is now the parish church. A friary for Eremites, following the rule of St Augustine, was also founded here in the reign of Edward III.

NEWSPAPERS, periodical publications, daily, weekly, &c. for the purpose of communicating to the world every thing of importance, whether political or literary, &c. which is going on. They have tended much to the dissemination of learning, and have served many other valuable purposes; and while they are carried on with candour, impartiality, and ability, they are unquestionably a great national benefit. When this, however, is not the case, and it often happens, they disgrace their authors, and are highly injurious to the public. They were first published in England, August 22. 1642. *Journal de Sçavans*, a French paper, was first published in 1665, though one was printed in England, under the title of the *Public Intelligencer*, by Sir Roger L'Estrange, 1663, which he dropped, on the publication of the first London Gazette. Newspapers and pamphlets were prohibited by royal proclamation 1680. Though at the Revolution prohibitions of this kind were done away, and the press set at liberty, yet newspapers were afterwards made objects of taxation, and for this purpose were first stamped in 1713. The number of them, however, gradually increased; and there were printed in the whole kingdom during the years 1775, 12,680,000; 1776, 12,830,000; 1777, 13,150,642; 1778, 13,240,059; 1779, 14,106,842; 1780, 14,217,371; 1781, 14,397,620; 1782, 15,272,519. They are now still more numerous. The average number of newspapers printed in England at the close of the reign of George II. was 9,464,790. The number in 1790, was 14,035,639; in 1792, it was 15,005,760. *Chalmers' Life of Ruddiman*, p. 442.

NEW STYLE, first used in England in 1753, was introduced into the western world by Pope Gregory XIII. See CHRONOLOGY, N° 24.

NEWT, or EFT, the common lizard. See LACERTA, ERPETOLOGY *Index*.

NEWTON, SIR ISAAC, one of the greatest philosophers and mathematicians the world has ever produced, was the only child of Mr John Newton of Colesworth, not far from Grantham in Lincolnshire, who had an estate of about 120l. per annum, which he kept in his own hands. He was born at that place on Christmas day 1642. His father dying when he was young, his mother's brother, a clergyman of the name of *Ayscough*, or *Askew*, who lived near her, and directed all her affairs after the death of Mr Newton, put her son to school at Grantham. When he had finished his school learning, his mother took him home, intending, as she had no other child, to have the pleasure of his company; and that he, as his father had done, should occupy his own estate. But his uncle happening to find him in a hay loft at Grantham working a mathematical problem, and having otherwise observed the boy's mind to be uncommonly bent upon learning, he prevailed upon her to part with him; and she sent him to Trinity College in Cambridge, where her brother, having himself been a member of it, had still many friends. Isaac was soon taken notice of by Dr Isaac Barrow; who, observing his bright genius, contracted a great friendship for him. M. de Fontenelle tells us, "That in learning mathematics he did not study Euclid, who seemed to him too plain and simple, and unworthy of taking up his time. He understood him almost before he read him; and a cast of his eye upon the contents of his theorems was sufficient to make him master of them. He advanced at once to the geometry of Des Cartes, Kepler's Optics, &c. It is certain that he had made his great discoveries in geometry, and laid the foundation of his two famous works, the *Principia* and *Optics*, by the time he was 24 years of age."

Newton.

In 1664, he took the degree of bachelor of arts; and in 1668 that of master, being elected the year before, fellow of his college. He had before this time discovered the method of fluxions; and in 1669 he was chosen professor of mathematics in the university of Cambridge, upon the resignation of Mr Barrow. The same year, and the two following, he read a course of optical lectures in Latin, in the public schools of the university; an English translation of which was printed at London in 1728, in 8vo, as was the Latin original the next year in 4to. From the year 1671 to 1679, he held a correspondence by letters with Mr Henry Oldenburg secretary of the Royal Society, and Mr John Collins fellow of that society; which letters contain a variety of curious observations.

Concerning the origin of his discoveries, we are told that as he sat alone in a garden, the falling of some apples from a tree led him into a speculation on the power of gravity; that as this power is not diminished at the remotest distance from the centre of the earth to which we can rise, it appeared to him reasonable to conclude, that it must extend much farther than was usually thought; and pursuing this speculation, by comparing the periods of the several planets with their distances from the sun, he found, that if any power like gravity held them in their courses, its strength must decrease in the duplicate proportion of the increase of distance. This inquiry was dropped; but resumed again, and gave rise to his writing the treatise which he published in 1687, under the name of *Mathematical Principles of Natural Philosophy*; a work looked upon as the production of a celestial intelligence rather than of a man. The very same year in which this great work was published, the university of Cambridge was attacked by King James II. when Mr Newton was one of its most zealous defenders, and was accordingly nominated one of the delegates of that university to the high-commission court; and the next year he was chosen one of their members for the convention parliament, in which he sat till it was dissolved. In 1696, Mr Montague, then chancellor of the exchequer, and afterwards earl of Halifax, obtained for him of the king the office of warden of the mint; in which employment he was of signal service, when the money was called in to be recoined. Three years after, he was appointed master of the mint; a place of very considerable profit, which he held till his death. In 1699, he was elected one of the members of the Royal Academy of Sciences at Paris. In 1701, he was a second

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time chosen member of parliament for the university of Cambridge. In 1704, he published his *Optics;* which is a piece of philosophy so new, that the science may be considered as entirely indebted to our author. In 1705, he was knighted by Queen Anne. In 1707, he published his *Arithmetica Universalis.* In 1711, his *Analysis per Quantitatum Series, Fluxiones et Differentias,* &c. was published by William Jones, Esq. In 1712, several letters of his were published in the *Commercium Epistolicum.* In the reign of George I. he was better known at court than before. The princess of Wales, afterwards queen consort of England, used frequently to propose questions to him, and to declare that she thought herself happy to live at the same time with him, and have the pleasure and advantages of his conversation. He had written a treatise of ancient chronology, which he did not think of publishing; but the princess desired an abstract, which she would never part with. However, a copy of it stole abroad, and was carried into France, where it was translated and printed, with some observations, which were afterwards answered by Sir Isaac. But, in 1728, the Chronology itself was published at London in quarto; and was attacked by several persons, and as zealously defended by Sir Isaac's friends. The main design of it was to find out, from some tracts of the most ancient Greek astronomy, what was the position of the colures with respect to the fixed stars, in the time of Chiron the centaur. As it is now known that these stars have a motion in longitude of one degree in 72 years, if it be once known through what fixed stars the colure passed in Chiron's time, by taking the distance of these stars from those through which it now passes, we might determine what number of years has elapsed since Chiron's time. As Chiron was one of the Argonauts, this would fix the time of that famous expedition, and consequently that of the Trojan war; the two great events upon which all ancient chronology depends. Sir Isaac places them 500 years nearer the birth of Christ than other chronologers have done.

This great man had all along enjoyed a settled and equal state of health to the age of 80, when he began to be afflicted with an incontinence of urine. However, for the five following years, he had great intervals of ease, which he procured by the observance of a strict regimen. It was then believed that he certainly had the stone; and when the paroxysms were so violent, that large drops of sweat ran down his face, he never uttered the least complaint, or expressed the smallest degree of impatience; but, as soon as he had a moment's ease, would smile and talk with his usual cheerfulness. Till then he always read and wrote several hours in a day. He had the perfect use of all his senses and understanding till the day before he died, which was on the 20th of March 1726-7, in the 85th year of his age. He lay in state in the Jerusalem chamber at Westminster, and on the 28th of March his body was conveyed into Westminster abbey; the pall being supported by the lord chancellor, the dukes of Montrose and Roxburgh, and the earls of Pembroke, Sussex, and Macclesfield. The bishop of Rochester read the funeral service, being attended by all the clergy of the church. The corpse was interred just at the entrance into the choir, where a noble monument is erected to his memory.

Sir Isaac was of a middling stature, and in the latter part of his life somewhat inclined to be fat. His countenance was pleasing, and at the same time venerable. He never made use of spectacles, and lost but one tooth during his whole life. Newton

His temper is said to have been so equal and mild, that no accident could disturb it. Of this the following remarkable instance is related. Sir Isaac had a favourite little dog, which he called *Diamond;* and being one day called out of his study into the next room, Diamond was left behind. When Sir Isaac returned, having been absent but a few minutes, he had the mortification to find, that Diamond having thrown down a lighted candle among some papers, the nearly finished labour of many years was in flames, and almost consumed to ashes. This loss, as Sir Isaac was then very far advanced in years, was irretrievable; yet without once striking the dog, he only rebuked him with this exclamation, "Oh! Diamond! Diamond! thou little knowest the mischief thou hast done!"

He was a great lover of peace, and would rather have chosen to remain in obscurity than to have the calm of life ruffled by those storms and disputes which genius and learning always draw upon those that are peculiarly eminent for them. In contemplating his genius it presently becomes a doubt, which of these endowments had the greatest share, sagacity, penetration, strength or diligence: and after all, the mark that seems most to distinguish it is, that he himself made the justest estimation of it, declaring, that, if he had done the world any service, it was due to nothing but industry and patient thought; that he kept the subject under consideration constantly before him, and waited till the first dawning opened gradually, by little and little, into a full and clear light. It is said, that when he had any mathematical problems or solutions in his mind, he would never quit the subject on any account. Dinner has been often three hours ready for him before he could be brought to table; and his man often said, when he has been getting up in a morning, he has sometimes begun to dress, and with one leg in his breeches sat down again on the bed, where he has remained for hours before he got his clothes on. From his love of peace, no doubt, arose that unusual kind of horror which he had for all disputes; a steady unbroken attention, free from those frequent recoilings inseparably incident to others, was his peculiar felicity; he knew it, and he knew the value of it. No wonder then that controversy was looked on as his bane. When some objections, hastily made to his discoveries concerning light and colours, induced him to lay aside the design he had of publishing his optic lectures, we find him reflecting on that dispute, into which he was unavoidably drawn thereby, in these terms: "I blamed my own imprudence for parting with so real a blessing as my quiet, to run after a shadow." It is true this shadow (as Mr Fontenelle observes) did not escape him afterwards, nor did it cost him that quiet which he so much valued, but proved as much a real happiness to him as his quiet itself; yet this was a happiness of his own making: he took a resolution, from these disputes, not to publish any more about that theory till he had put it above the reach of controversy, by the exactest experiments and the strictest demonstrations; and accordingly it has never been called in question since. In the same temper, after

Newton. ter he had sent the manuscript of his *Principia* to the Royal Society, with his consent to the printing of it by them, upon Mr Hook's injuriously insisting that himself had demonstrated Kepler's problem before our author, he determined, rather than be involved again in a controversy, to suppress the third book, and was very hardly prevailed upon to alter that resolution. It is true, the public was thereby a gainer; that book, which is indeed no more than a corollary of some propositions in the first, being originally drawn up in the popular way, with the design to publish it in that form; whereas he was now convinced that it would be best not to let it go abroad without a strict demonstration.

After all, notwithstanding his anxious care to avoid every occasion of breaking his intense application to study, he was at a great distance from being steeped in philosophy: on the contrary, he could lay aside his thoughts, though engaged in the most intricate researches, when his other affairs required his attendance; and as soon as he had leisure, resume the subject at the point where he had left off. This he seems to have done not so much by any extraordinary strength of memory, as by the force of his inventive faculty, to which every thing opened itself again with ease, if nothing intervened to ruffle him. The readiness of his invention made him not think of putting his memory much to trial: but this was the offspring of a vigorous intenseness of thought, out of which he was but a common man. He spent therefore, the prime of his age in those abstruse researches, when his situation in a college gave him leisure, and even while study was his proper profession. But as soon as he was removed to the mint, he applied himself chiefly to the business of that office; and so far quitted mathematics and philosophy, as not to engage in any pursuits of either kind afterwards.

The amiable quality of modesty is represented as standing foremost in the character of this great man's mind and manners. It was in reality greater than can be easily imagined, or will be readily believed; yet it always continued so without any alteration, though the whole world, says Fontenelle, conspired against it; and let us add, though he was thereby robbed of his invention of fluxions. Nicholas Mercator publishing his *Logarithmotechnia* in 1668, where he gave the quadrature of the hyperbola by an infinite series, which was the first appearance in the learned world of a series of this sort drawn from the particular nature of the curve, and that in a manner very new and abstracted; Dr Barrow, then at Cambridge, where Mr Newton, at that time about 26 years of age, resided, recollected that he had met with the same thing in the writings of that young gentleman; and there not confined to the hyperbola only, but extended, by general forms, to all sorts of curves, even such as are mechanical; to their quadratures, their rectifications, and their centres of gravity; to the solids formed by their rotations, and to the superficies of those solids; so that, when their determinations were possible, the series stopped at a certain point, or at least their sums were given by stated rules: and, if the absolute determinations were impossible, they could yet be infinitely approximated; which is the happiest and most refined method, says Mr Fontenelle, of supplying the defects of human knowledge that man's imagination could possibly invent. To be master of so fruitful and general a theory was a mine of gold to a geometrician; but it was a greater glory to Newton. have been the discoverer of so surprising and ingenious a system. So that Mr Newton finding, by Mercator's book, that he was in the way to it, and that others might follow in his track, should naturally have been forward to open his treasures, and secure the property, which consisted in making the discovery; but he contented himself with his treasure which he had found, without regarding the glory. What an idea does it give us of his unparalleled modesty, when we see him declaring, that he thought Mercator had entirely discovered his secret, or that others would, before he was of a proper age for writing? His MS. upon infinite series was communicated to none but Mr John Collins and the lord Brounker; and even that had not been complied with, but for Dr Barrow, who would not suffer him to indulge his modesty so much as he desired.

It is further observed, concerning this part of his character, that he never talked either of himself or others, nor ever behaved in such a manner as to give the most malicious censurers the least occasion even to suspect him of vanity. He was candid and affable, and always put himself upon a level with his company. He never thought either his merit or his reputation sufficient to excuse him from any of the common offices of social life; no singularities, either natural or affected, distinguished him from other men. Though he was firmly attached to the church of England, he was averse to the persecution of the non-conformists. He judged of men by their manners; and the true schismatics, in his opinion, were the vicious and the wicked. Not that he confined his principles to natural religion, for he was thoroughly persuaded of the truth of revelation; and amidst the great variety of books which he had constantly before him, that which he studied with the greatest application was the Bible: and he understood the nature and force of moral certainty as well as he did that of a strict demonstration.

Sir Isaac did not neglect the opportunities of doing good, when the revenues of his patrimony, and a profitable employment, improved by a prudent economy, put it in his power. We have two remarkable instances of his bounty and generosity; one to Mr M'Laurin, professor of mathematics at Edinburgh, to whom he offered 20l. per annum, and the other to his niece Barton, on whom he settled an annuity of 100l. When decency upon any occasion required expence and show, he was magnificent without grudging it, and with a very good grace; at all other times, that pomp which seems great to low minds only, was utterly retrenched, and the expence reserved for better uses. He never married, and perhaps he never had leisure to think of it. Being immersed in profound studies during the prime of his age, and afterwards engaged in an employment of great importance, and even quite taken up with the company which his merit drew to him, he was not sensible of any vacancy in life, or of the want of a companion at home. He left 32,000l. at his death; but made no will, which Mr Fontenelle tells us was because he thought a legacy was no gift. As to his works, besides what were published in his lifetime, there were found after his death, among his papers, several discourses upon subjects of antiquity, history, divinity, chemi-

Newton, Newtonian Philosophy.

stry, and mathematics, several of which were published at different times.

Newtonian Philosophy, the doctrine of the universe, and particularly of the heavenly bodies, their laws, affections, &c. as delivered by Sir Isaac Newton.

1 Different opinions concerning this philosophy.

The term *Newtonian Philosophy* is applied very differently; whence divers confused notions relating thereto. Some authors under this philosophy include all the corpuscular philosophy, considered as it now stands corrected and reformed by the discoveries and improvements made in several parts thereof by Sir Isaac Newton. In which sense it is that Gravesande calls his elements of physics, *Introductio ad Philosophiam Newtonianam*. And in this sense the Newtonian is the same with the new philosophy; and stands contradistinguished from the Cartesian, the Peripatetic, and the ancient Corpuscular.

Others, by *Newtonian philosophy*, mean the method or order which Sir Isaac Newton observes in philosophizing; viz. the reasoning and drawing of conclusions directly from phenomena, exclusive of all previous hypotheses; the beginning from simple principles; deducing the first powers and laws of nature from a few select phenomena, and then applying those laws, &c. to account for other things. And in this sense the *Newtonian philosophy* is the same with the *experimental philosophy*, and stands opposed to the ancient *corpuscular*.

Others, by *Newtonian philosophy*, mean that wherein physical bodies are considered mathematically, and where geometry and mechanics are applied to the solution of the appearances of nature. In which sense the Newtonian is the same with the *mechanical* and *mathematical philosophy*.

Others again, by *Newtonian philosophy*, understand that part of physical knowledge which Sir Isaac Newton has handled, improved, and demonstrated, in his *Principia*.

Others, lastly, by *Newtonian philosophy*, mean the new principles which Sir Isaac Newton has brought into philosophy; the new system founded thereon; and the new solutions of phenomena thence deduced; or that which characterizes and distinguishes his philosophy from all others.—Which is the sense wherein we shall chiefly consider it.

As to the history of this philosophy, we have nothing to add to what has been given in the preceding article. It was first made public in the year 1687, by the author, then a fellow of Trinity College, Cambridge, and in the year 1713, republished with considerable improvements.—Several authors have since attempted to make it plainer; by setting aside many of the more sublime mathematical researches, and substituting either more obvious reasonings or experiments in lieu thereof; particularly Whiston in his *Prælect. Phys. Mathemat.* Gravesande in *Element. et Instit.* and Dr Pemberton in his *View*.

2 Definitions on which the philosophy is founded.

The whole of the *Newtonian philosophy*, as delivered by the author, is contained in his *Principia* or *Mathematical Principles of Natural Philosophy*. He founds his system on the following definitions:

1. The quantity of matter is the measure of the same, arising from its density and bulk conjunctly.—Thus air of a double density, in a double space, is quadruple in quantity; in a triple space, sextuple in quantity, &c.

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2. The quantity of motion is the measure of the same, arising from the velocity and quantity of matter conjunctly. This is evident, because the motion of the whole is the motion of all its parts; and therefore in a body double in quantity, with equal velocity, the motion is double, &c.

3 *Vis insita* defined and objected to.

3. The *vis insita*, or innate force of matter, is a power of resisting, by which every body, as much as in it lies, endeavours to persevere in its present state, whether it be of rest, or moving uniformly forward in a right line.—This definition is proved to be just, only by the difficulty we find in moving any thing out of its place; and this difficulty is by some reckoned to proceed only from gravity. They contend, that in those cases where we can prevent the force of gravity from acting upon bodies, this power of resistance becomes insensible, and the greatest quantities of matter may be put in motion by the very least force. Thus there have been balances formed so exact, that when loaded with 200 weight in each scale, they would turn by the addition of a single drachm. In this case 400lb. of matter was put in motion by a single drachm, i. e. by $\frac{1}{3\,1\,2\,0\,0}$ part of its own quantity: and even this small weight, they say, is only necessary on account of the inaccuracy of the machine: so that we have no reason to suppose, that, if the friction could be entirely removed, it would take more force to move a tun weight than a grain of sand. This objection, however, is not taken notice of by Sir Isaac: and he bestows on the resisting power above mentioned the name of *vis inertiæ*; a phrase which is perhaps not well chosen, and with which inferior writers have endeavoured to make their readers merry at the expence of Newton. A *force of inactivity*, it has been said, is a *forceless* force; and analogous to a *black white*, a *cold heat*, and a *tempestuous calm*.

But objections of more importance have been made to the whole of this doctrine than those which merely respect the term *vis inertiæ*. "An endeavour to remain at rest (we are told *) is unnecessary, whilst nothing attempts to disturb the rest. It is likewise impossible to be conceived, as it implies a contradiction. A man, by opposing force to force, may endeavour not to be moved; but this opposition is an endeavour to *move*, not with a design to *move*, but by counteracting another force to *prevent* being moved. An endeavour not to move therefore cannot exist in bodies, because it is absurd; and if we appeal to fact, we shall find every body in an actual and constant endeavour to move." It has been likewise observed, and we think justly, that "if bodies could *continue* to move by any innate force, they might also *begin* to move by that force. For the same cause which can move a body with a given velocity at one time, could do it, if present, at any other time; and therefore if the force by which bodies continue in motion were innate and essential to them, they would begin to move of themselves, which is not true." Newton indeed says that this innate force is the cause of motion under certain circumstances only, or when the body is acted upon by a force impressed *ab extra*. But if this impressed force do not continue as well

* *Young's Examination of the third and fourth Definitions of the first Book of the Principia*, &c.

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as begin the motion, if it cease the instant that the impression is over, and the body continue to move by its *vis inertiæ*, why is the body ever stopped? "If in the beginning of the motion the body, by its innate force, overcomes a certain resistance of friction and air, in any following times, the force being undiminished, it will overcome the same resistance for ever. These resistances, therefore, could never change the state of a moving body, because they cannot change the quantity of its motive force. But this is contrary to universal experience." For these reasons we are inclined to think that bodies are wholly passive; that they endeavour nothing; and that they continue in motion not by any innate force or *vis insita*, but by that force, whatever it be, which begins the motion, and which, whilst it remains with the moving body, is gradually diminished, and at last overcome by opposite forces, when the body of course ceases to move.

4. An impressed force is an action exerted upon a body, in order to change its state, either of rest or of moving uniformly forward in a right line.—This force consists in the action only; and remains no longer in the body when the action is over. For a body maintains every new state it acquires by its *vis inertiæ* only.

It is here implied, and indeed fully expressed, that motion is not continued by the same power that produced it. Now there are two grounds on which the truth of this doctrine may be supposed to rest.

"*First*, On a direct proof that the impressed force does not remain in the body, either by showing the nature of the force to be transitory and incapable of more than its first action; or that it acts only on the surface, and that the body escapes from it; or that the force is somewhere else, and not remaining in the body. But none of these direct proofs are offered.

"*Secondly*, It may rest on an indirect proof, that there is in the nature of body a sufficient cause for the continuance of every new state acquired; and that therefore any adventitious force to continue motion, though necessary for its production, is superfluous and inadmissible. As this is the very ground on which the supposition stands, it ought to have been indubitably certain that the innate force of the body is sufficient to perpetuate the motion it has once acquired, before the other agent, by which the motion was communicated, had been dismissed from the office. But the innate force of body has been shown not to be that which continues its motion; and therefore the proof, that the impressed force does not remain in the body, fails. Nor indeed is it in this case desirable to support the proof, because we should then be left without any reason for the continuance of motion*." When we mention an impressed force, we mean such a force as is communicated either at the surface of the body or by being diffused through the mass.

* *Young's Examination, &c.*

5. A centripetal force is that by which bodies are drawn, impelled, or any way tend towards a point, as to a centre.—The quantity of any centripetal force may be considered as of three kinds, absolute, accelerative, and motive.

6. The absolute quantity of a centrifugal force is the measure of the same, proportional to the efficacy of the cause that propagates it from the centre, through the spaces round it.

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7. The accelerative quantity of a centripetal force is the measure of the same, proportional to the velocity which it generates in a given time.

8. The motive quantity of a centripetal force is a measure of the same, proportional to the motion which it generates in a given time. This is always known by the quantity of a force equal and contrary to it, that is just sufficient to hinder the descent of the body.

Scholia.

4 Of time.

I. Absolute, true, and mathematical time, of itself, and from its own nature, flows equably, without regard to any thing external, and, by another name, is called *duration*. Relative, apparent, and common time, is some sensible and external measure of duration, whether accurate or not, which is commonly used instead of true time; such as an hour, a day, a month, a year, &c.

5 Space.

II. Absolute space, in its own nature, without regard to any thing external, remains always similar and immoveable. Relative space is some moveable dimension or measure of the absolute spaces; and which is vulgarly taken for immoveable space. Such is the dimension of a subterraneous, an aerial, or celestial space, determined by its position to bodies, and which is vulgarly taken for immoveable space; as the distance of a subterraneous, an aerial, or celestial space, determined by its position in respect of the earth. Absolute and relative space are the same in figure and magnitude; but they do not remain always numerically the same. For if the earth, for instance, moves, a space of our air which, relatively and in respect of the earth, remains always the same, will at one time be one part of the absolute space into which the earth passes; at another time it will be another part of the same; and so, absolutely understood, it will be perpetually mutable.

6 Place defined.

III. Place is a part of space which a body takes up; and is, according to the space, either absolute or relative. Our author says it is *part* of space; not the situation, nor the external surface of the body. For the places of equal solids are always equal; but their superficies, by reason of their dissimilar figures, are often unequal. Positions properly have no quantity, nor are they so much the places themselves as the properties of places. The motion of the whole is the same thing with the sum of the motions of the parts; that is, the translation of the whole out of its place is the same thing with the sum of the translations of the parts out of their places: and therefore the place of the whole is the same thing with the sum of the places of the parts; and for that reason it is internal, and in the whole body.

7 Of Motion.

IV. Absolute motion is the translation of a body from one absolute place into another, and relative motion the translation from one relative place into another. Thus, in a ship under sail, the relative place of a body is that part of the ship which the body possesses, or that part of its cavity which the body fills, and which therefore moves together with the ship; and relative rest is the continuance of the body in the same part of the ship, or of its cavity. But real

absolute

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absolute rest is the continuance of the body in the same part of that immoveable space in which the ship itself, its cavity, and all that it contains, is moved. Wherefore, if the earth is really at rest, the body which relatively rests in the ship will really and absolutely move with the same velocity which the ship has on the earth. But if the earth also moves, the true and absolute motion of the body will arise, partly from the true motion of the earth in immoveable space; partly from the relative motion of the ship on the earth: and if the body moves also relatively in the ship, its true motion will arise partly from the true motion of the earth in immoveable space, and partly from the relative motions as well of the ship on the earth as of the body in the ship; and from these relative motions will arise the relative motion of the body on the earth. As if that part of the earth where the ship is, was truly moved towards the east, with a velocity of 10010 parts; while the ship itself with a fresh gale is carried towards the west, with a velocity expressed by 10 of these parts; but a sailor walks in the ship towards the east with one part of the said velocity: then the sailor will be moved truly and absolutely in immoveable space towards the east with a velocity of 1001 parts: and relatively on the earth towards the west, with a velocity of 9 of those parts.

Absolute time, in astronomy, is distinguished from relative, by the equation or correction of the vulgar time. For the natural days are truly unequal, though they are commonly considered as equal, and used for a measure of time: astronomers correct this inequality for their more accurate deducing of the celestial motions. It may be that there is no such thing as an equable motion whereby time may be accurately measured. All motions may be accelerated or retarded; but the true or equable progress of absolute time is liable to no change. The duration or perseverance of the existence of things remains the same, whether the motions are swift or slow, or none at all; and therefore ought to be distinguished from what are only sensible measures thereof, and out of which we collect it by means of the astronomical equation. The necessity of which equation for determining the times of a phenomenon is evinced, as well from the experiments of the pendulum clock as by eclipses of the satellites of Jupiter.

8 Immutability of time and space.

As the order of the parts of time is immutable, so also is the order of the parts of space. Suppose those parts to be moved out of their places, and they will be moved (if we may be allowed the expression) out of themselves. For times and spaces are, as it were, the places of themselves as of all other things. All things are placed in time as to order of succession; and in space as to order of situation. It is from their essence or nature that they are places; and that the primary places of things should be moveable is absurd. These are therefore the absolute places; and translations out of those places are the only absolute motions.

But because the parts of space cannot be seen, or distinguished from one another by the senses, therefore in their stead we use sensible measures of them. For, from the positions and distances of things from any body, considered as immoveable, we define all place; and then with respect to such places, we estimate all motions, considering bodies as transferred from some of those places into others. And so, instead of absolute places and motions, we use relative ones; and that without any inconvenience in common affairs: but in philosophical disquisitions we ought to abstract from our senses, and consider things themselves distinct from what are only sensible measures of them. For it may be, that there is no body really at rest, to which the places and motions of others may be referred.

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But we may distinguish rest and motion, absolute and relative, one from the other, by their properties, causes, and effects. It is a property of rest, that bodies really at rest do rest in respect of each other. And therefore, as it is possible, that in the remote regions of the fixed stars, or perhaps far beyond them, there may be some body absolutely at rest, though it be impossible to know from the position of bodies to one another in our regions, whether any of these do keep the same position to that remote body; it follows, that absolute rest cannot be determined from the position of bodies in our regions.

9 Of the motion of different bodies with respect to one another.

It is a property of motion, that the parts which retain given positions to their wholes do partake of the motion of their wholes. For all parts of revolving bodies endeavour to recede from the axis of motion; and the impetus of bodies moving forwards arises from the joint impetus of all the parts. Therefore if surrounding bodies are moved, those that are relatively at rest within them will partake of their motion. Upon which account the true and absolute motion of a body cannot be determined by the translation of it from those only which seem to rest; for the external bodies ought not only to appear at rest, but to be really at rest. For otherwise all included bodies, beside their translation from near the surrounding ones, partake likewise of their true motions; and though that translation was not made, they would not really be at rest, but only seem to be so. For the surrounding bodies stand in the like relation to the surrounded, as the exterior part of a whole does to the interior, or as the shell does to the kernel; but if the shell moves, the kernel will also move, as being part of the whole, without any removal from near the shell.

A property near akin to the preceding is, that if a place is moved, whatever is placed therein moves along with it; and therefore a body which is moved from a place in motion, partakes also of the motion of its place. Upon which account all motions from places in motion, are no other than parts of entire and absolute motions; and every entire motion is composed of the motion of the body out of its first place, and the motion of this place out of its place; and so on, until we come to some immoveable place, as in the above-mentioned example of the sailor. Wherefore entire and absolute motions can be no otherwise determined than by immoveable places. Now, no other places are immoveable but those that from infinity to infinity do all retain the same given positions one to another; and upon this account must ever remain unmoved, and do thereby constitute what we call *immoveable space*.

The causes by which true and relative motions are distinguished one from the other, are the forces impressed

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pressed upon bodies to generate motion. True motion is neither generated nor altered, but by some force impressed upon the body moved: but relative motion may be generated or altered without any force impressed upon the body. For it is sufficient only to impress some force on other bodies with which the former is compared, that by their giving way, that relation may be changed, in which the relative rest or motion of the other body did consist. Again, True motion suffers always some change from any force impressed upon the moving body; but relative motion does not necessarily undergo any changes by such force. For if the same forces are likewise impressed on those other bodies with which the comparison is made, that the relative position may be preserved; then that condition will be preserved, in which the relative motion consists. And therefore any relative motion may be changed when the true motion remains unaltered, and the relative may be preserved when the true motion suffers some change. Upon which account true motion does by no means consist in such relations.

10 Absolute and relative motion distinguished.

The effects which distinguish absolute from relative motion are, the forces of receding from the axis of circular motion. For there are no such forces in a circular motion purely relative; but in a true and absolute circular motion, they are greater or less according to the quantity of the motion. If a vessel hung by a long cord, is so often turned about that the cord is strongly twisted, then filled with water, and let go, it will be whirled about the contrary way; and while the cord is untwisting itself, the surface of the water will at first be plain, as before the vessel began to move; but the vessel, by gradually communicating its motion to the water, will make it begin sensibly to revolve, and recede by little and little from the middle, and ascend to the sides of the vessel, forming itself into a concave figure; and the swifter the motion becomes, the higher will the water rise, till at last, performing its revolutions in the same times with the vessel, it becomes relatively at rest in it. This ascent of the water shows its endeavour to recede from the axis of its motion; and the true and absolute circular motion of the water, which is here directly contrary to the relative, discovers itself, and may be measured by this endeavour. At first, when the relative motion in the water was greatest, it produced no endeavour to recede from the axis; the water showed no tendency to the circumference, nor any ascent towards the sides of the vessel, but remained of a plane surface; and therefore its true circular motion had not yet begun. But afterwards, when the relative motion of the water had decreased, the ascent thereof towards the sides of the vessel proved its endeavour to recede from the axis; and this endeavour showed the real circular motion of the water perpetually increasing, till it had acquired its greatest quantity, when the water rested relatively in the vessel. And therefore this endeavour does not depend upon any translation of the water in repect of the ambient bodies; nor can true circular motion be defined by such translations. There is only one real circular motion of any one revolving body, corresponding to only one power of endeavouring to recede from its axis of motion, as its proper and adequate effect; but relative motions in one and the same body are innumerable, according to the various relations it bears to external bodies; and, like other relations, are altogether destitute of any real effect, otherwise than they may perhaps participate of that only true motion. And therefore, in the system which supposes that our heavens, revolving below the sphere of the fixed stars, carry the planets along with them, the several parts of those heavens and the planets, which are indeed relatively at rest in their heavens, do yet really move. For they change their position one to another, which never happens to bodies truly at rest; and being carried together with the heavens, partieipate of their motions, and, as parts of revolving wholes, endeavour to recede from the axis of their motion.

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Wherefore relative quantities are not the quantities themselves whose names they bear, but those sensible measures of them, either accurate or inaccurate, which are commonly used instead of the measured quantities themselves. And then, if the meaning of words be determined by their use, by the names *time*, *space*, *place*, and *motion*, their measures are properly to be understood; and the expression will be unusual and purely mathematical, if the measured quantities themselves are meant.

It is indeed a matter of great difficulty to discover, and effectually to distinguish, the true motions of particular bodies from those that are only apparent: because the parts of that immoveable space in which those motions are performed, do by no means come under the observation of our senses. Yet we have some things to direct us in this intricate affair; and these arise partly from the apparent motions which are the difference of the true motions, partly from the forces which are the causes and effects of the true motions. For instance, if two globes kept at a given distance one from the other by means of a cord that connects them, were revolved about their common centre of gravity; we might, from the tension of the cord, discover the endeavour of the globes to recede from the axis of motion, and from thence we might compute the quantity of their circular motions. And then, if any equal forces should be impressed at once on the alternate faces of the globes to augment or diminish their circular motions, from the increase or decrease of the tension of the cord we might infer the increment or decrement of their motions; and thence would be found on what faces those forces ought to be impressed, that the motions of the globes might be most augmented; that is, we might discover their hindermost faces, or those which follow in the circular motion. But the faces which follow being known, and consequently the opposite ones that precede, we should likewise know the determination of their motions. And thus we might find both the quantity and determination of this circular motion, even in an immense vacuum, where there was nothing external or sensible with which the globes might be compared. But now, if in that space some remote bodies were placed that kept always a given position one to another, as the fixed stars do in our regions; we could not indeed determine from the relative translation of the globes among those bodies, whether the motion did belong to the globes or to the bodies. But if we observed the cord, and found that its tension was that very tension which the motions of the globes required, we might conclude the motion to be in the globes, and the bodies to

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be at rest; and then, lastly, from the translation of the globes among the bodies, we should find the determination of their motions.

Having thus explained himself, Sir Isaac proposes to show how we are to collect the true motions from their causes, effects, and apparent differences; and *vice versa*, how from the motion, either true or apparent, we may come to the knowledge of their causes and effects. In order to this, he lays down the following axioms or laws of motion.

11 Laws of motion.

1. EVERY BODY PERSEVERES IN ITS STATE OF REST, OR OF UNIFORM MOTION IN A RIGHT LINE, UNLESS IT IS COMPELLED TO CHANGE THAT STATE BY FORCES IMPRESSED UPON IT.—Sir Isaac's proof of this axiom is as follows: "Projectiles persevere in their motions, so far as they are not retarded by the resistance of the air, or impelled downwards by the force of gravity. A top, whose parts, by their cohesion, are perpetually drawn aside from rectilinear motion, does not cease its rotation otherwise than as it is retarded by the air. The greater bodies of the planets and comets, meeting with less resistance in more free spaces, preserve their motions, both progressive and circular, for a much longer time."—Notwithstanding this demonstration, however, the axiom hath been violently disputed. It hath been argued, that bodies continue in their state of motion because they are subjected to the continual impulse of an invisible and subtile fluid, which always pours in from behind, and of which all places are full. It hath been affirmed, that motion is as natural to this fluid as rest is to all other matter. It is said, moreover, that it is impossible we can know in what manner a body would be influenced by moving forces if it was entirely destitute of gravity. According to what we can observe, the momentum of a body, or its tendency to move, depends very much on its gravity. A heavy cannon-ball will fly to a much greater distance than a light one, though both are actuated by an equal force. It is by no means clear, therefore, that a body totally destitute of gravity would have any proper momentum of its own; and if it had no momentum, it could not continue its motion for the smallest space of time after the moving power was withdrawn. Some have imagined that matter was capable of beginning motion of itself, and consequently that the axiom was false; because we see plainly that matter in some cases hath a tendency to change from a state of motion to a state of rest, and from a state of rest to a state of motion. A paper appeared on this subject in the first volume of the Edinburgh Physical and Literary Essays; but the hypothesis never gained any ground.

12 Objections to the first law.

2. THE ALTERATION OF MOTION IS EVER PROPORTIONAL TO THE MOTIVE FORCE IMPRESSED; AND IS MADE IN THE DIRECTION OF THE RIGHT LINE IN WHICH THAT FORCE IS IMPRESSED.—Thus, if any force generates a certain quantity of motion, double force will generate a double quantity, whether that force be impressed all at once, or in successive moments. To this law no objection of consequence has ever been made. It is founded on this self-evident truth, that every effect must be proportional to its cause. Mr Young, who seems to be very ambitious of detecting the errors of Newton, finds fault indeed with the expressions in which the law is stated; but he owns, that if thus expressed, *The alteration of motion is proportional to the actions or resistance which produces it, and is in the direction in which the actions or resistances are made*, it would be unexceptionable.

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3. TO EVERY ACTION THERE ALWAYS IS OPPOSED AN EQUAL RE-ACTION: OR, THE MUTUAL ACTION OF TWO BODIES UPON EACH OTHER IS ALWAYS EQUAL, AND DIRECTED TO CONTRARY PARTS.—This axiom is also disputed by many. In the above-mentioned paper in the Physical Essays, the author endeavours to make a distinction between re-action and resistance; and the same attempt has been made by Mr Young. "When an action generates no motion (says he) it is certain that its effects have been destroyed by a contrary and equal action. When an action generates two contrary and equal motions, it is also evident that mutual actions were exerted, equal and contrary to each other. All cases where one of these conditions is not found, are exceptions to the truth of the law. If a finger presses against a stone, the stone, if it does not yield to the pressure, presses as much upon the finger; but if the stone yields, it re-acts less than the finger acts; and if it should yield with all the momentum that the force of the pressure ought to generate, which it would do if it were not impeded by friction, or a medium, it would not re-act at all. So if the stone drawn by a horse, follows after the horse, it does not re-act so much as the horse acts; but only so much as the velocity of the stone is diminished by friction, and it is the re-action of friction only, not of the stone. The stone does not re-act, because it does not act; it resists, but resistance is not action.

13 Objections to the third law.

"In the loss of motion from a striking body, equal to the gain in the body struck, there is a plain solution without requiring any re-action. The motion *lost* is identically that which is *found* in the other body; this supposition accounts for the whole phenomenon in the most simple manner. If it be not admitted, but the solution by re-action is insisted upon, it will be incumbent on the party to account for the whole effect of communication of motion: otherwise he will lie under the imputation of rejecting a solution which is simple, obvious, and perfect; for one complex, unnatural, and incomplete. However this may be determined, it will be allowed, that the circumstances mentioned, afford no ground for the inference, that action and re-action are equal, since appearances may be explained in another way." (A.)

Others

(A) If there be a perfect reciprocity betwixt an impinging body and a body at rest sustaining its impulse, may we not at our pleasure consider either body as the agent, and the other as the resistant? Let a moving body, A, pass from north to south, an equal body B at rest, which receives the stroke of A, act upon A from south to north, and A resist in a contrary direction, both inelastic: let the motion reciprocally communicated be called six. Then B at rest communicates to A six degrees of motion towards the north, and receives six degrees towards the south. B having no other motion than the six degrees it communicated, will, by its

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Others grant that Sir Isaac's axiom is very true in respect to terrestrial substances; but they affirm, that, in these, both action and re-action are the effects of gravity. Substances void of gravity would have no momentum; and without this they could not act; they should be moved by the least force, and therefore could not resist or re-act. If therefore there is any fluid which is the cause of gravity, though such fluid could act upon terrestrial substances, yet these could not re-act upon it; because they have no force of their own, but depend entirely upon it for their momentum. In this manner, say they, we may conceive that the planets circulate, and all the operations of nature are carried on by means of a subtile fluid; which being perfectly active, and the rest of matter altogether passive, there is neither resistance nor loss of motion. See MOTION.

From the preceding axiom Sir Isaac draws the following corollaries.

1. A body by two forces conjoined will describe the diagonal of a parallelogram in the same time that it would describe the sides by those forces apart.

2. Hence we may explain the composition of any one direct force out of any two oblique ones, viz. by making the two oblique forces the sides of a parallelogram, and the direct one the diagonal.

3. The quantity of motion, which is collected by taking the sum of the motions directed towards the same parts, and the difference of those that are directed to contrary parts, suffers no change from the action of bodies among themselves: because the motion which one body loses is communicated to another; and if we suppose friction and the resistance of the air to be absent, the motion of a number of bodies which mutually impelled one another would be perpetual, and its quantity always equal.

4. The common centre of gravity of two or more bodies do not alter its state of motion or rest by the actions of the bodies among themselves; and therefore the common centre of gravity of all bodies acting upon each other (excluding outward actions and impediments) is either at rest, or moves uniformly in a right line. Newtonian Philosophy.

5. The motions of bodies included in a given space are the same among themselves, whether that space is at rest, or moves uniformly forward in a right line without any circular motion. The truth of this is evidently shown by the experiment of a ship; where all motions happen after the same manner, whether the ship is at rest, or proceeds uniformly forward in a straight line.

6. If bodies, anyhow moved among themselves, are urged in the direction of parallel lines by equal accelerative forces, they will all continue to move among themselves, after the same manner as if they had been urged by no such forces.

The whole of the mathematical part of the Newtonian philosophy depends on the following lemmas; of which the first is the principal.

LEM. I. Quantities, and the ratios of quantities, which in any finite time converge continually to equality, and before that time approach nearer the one to the other than by any given difference, become ultimately equal. If you deny it; suppose them to be ultimately unequal, and let D be their ultimate difference. Therefore they cannot approach nearer to equality than by that given difference D; which is against the supposition.

Concerning the meaning of this lemma philosophers are not agreed; and unhappily it is the very fundamental position on which the whole of the system rests. Many objections have been raised to it by people who 14 Objections to the first lemma.

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equal and contrary loss and gain, remain in equilibrio. Let the original motion of A have been twelve, then A having received a contrary action equal to six, six degrees of its motion will be destroyed or in equilibrio; consequently, a motive force as six will remain to A towards the south, and B will be in equilibrio, or at rest. A will then endeavour to move with six degrees, or half its original motion, and B will remain at rest as before. A and B being equal masses, by the laws of communication three degrees of motion will be communicated to B, or A with its six degrees will act with three, and B will re-act also with three. B then will act on A from south to north equal to three, while it is acted upon or resisted by A from north to south, equal also to three, and B will remain at rest as before; A will also have its six degrees of motion reduced to one half by the contrary action of B, and only three degrees of motion will remain to A, with which it will yet endeavour to move; and finding B still at rest, the same process will be repeated till the whole motion of A is reduced to an infinitely small quantity, B all the while remaining at rest, and there will be no communication of motion from A to B, which is contrary to experience.

Let a body, A, whose mass is twelve, at rest, be impinged upon first by B, having a mass as twelve, and a velocity as four, making a momentum of 48; and secondly by C, whose mass is six, and velocity eight, making a momentum of 48 equal to B, the three bodies being inelastic. In the first case, A will become possessed of a momentum of 24, and 24 will remain to B; and, in the second case, A will become possessed of a momentum of 32, and 16 will remain to C, both bodies moving with equal velocities after the shock, in both cases, by the laws of percussion. It is required to know, if in both cases A resists equally, and if B and C act equally? if the actions and resistances are equal, how does A in one case destroy 24 parts of B's motion, and in the other case 32 parts of C's motion, by an equal resistance? And how does B communicate in one case 24 degrees of motion, and C 32, by equal actions? If the actions and resistances are unequal, it is asked how the same mass can resist differently to bodies impinging upon it with equal momenta, and how bodies possessed of equal momenta can exert different actions, it being admitted that bodies resist proportional to their masses, and that their power of overcoming resistance is proportional to their momenta?

It is incumbent on those who maintain the doctrine of universal re-action, to free it from these difficulties and apparent contradictions.

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supposed themselves capable of understanding it. They say, that it is impossible we can come to an end of any infinite series, and therefore that the word *ultimate* can in this case have no meaning. In some cases the lemma is evidently false. Thus, suppose there are two quantities of matter A and B, the one containing half a pound, and the other a third part of one. Let both be continually divided by 2; and though their ratio, or the proportion of the one to the other, doth not vary, yet the difference between them perpetually becomes less, as well as the quantities themselves, until both the difference and quantities themselves become less than any assignable quantity: yet the difference will never totally vanish, nor the quantities become equal, as is evident from the two following series:

$\frac{1}{2}\ \frac{1}{4}\ \frac{1}{8}\ \frac{1}{16}\ \frac{1}{32}\ \frac{1}{64}\ \frac{1}{128}\ \frac{1}{256}\ \frac{1}{512}\ \frac{1}{1024}$, &c.
$\frac{1}{3}\ \frac{1}{6}\ \frac{1}{12}\ \frac{1}{24}\ \frac{1}{48}\ \frac{1}{96}\ \frac{1}{192}\ \frac{1}{384}\ \frac{1}{768}\ \frac{1}{1536}$, &c.
Diff. $\frac{1}{6}\ \frac{1}{12}\ \frac{1}{24}\ \frac{1}{48}\ \frac{1}{96}\ \frac{1}{192}\ \frac{1}{384}\ \frac{1}{768}\ \frac{1}{1536}\ \frac{1}{3072}$, &c.

Thus we see, that though the difference is continually diminishing, and that in a very large proportion, there is no hope of its vanishing, or the quantities becoming equal. In like manner, let us take the proportions or ratios of quantities, and we shall be equally unsuccessful. Suppose two quantities of matter, one containing 8 and the other 10 pounds; these quantities already have to each other the ratio of 8 to 10, or of 4 to 5; but let us add 2 continually to each of them, and though the ratios continually come nearer to that of equality, it is in vain to hope for a perfect coincidence. Thus,

8 10 12 14 16 18 20 22 24, &c.
10 12 14 16 18 20 22 24 26, &c.
Ratio $\frac{4}{5}\ \frac{5}{6}\ \frac{6}{7}\ \frac{7}{8}\ \frac{8}{9}\ \frac{9}{10}\ \frac{10}{11}\ \frac{11}{12}\ \frac{12}{13}$, &c.

15 answered.

For this and his other lemmas Sir Isaac makes the following apology: "These lemmas are premised, to avoid the tediousness of deducing perplexed demonstrations *ad absurdum*, according to the method of ancient geometers. For demonstrations are more contracted by the method of indivisibles: but because the hypothesis of indivisibles seems somewhat harsh, and therefore that method is reckoned less geometrical, I chose rather to reduce the demonstrations of the following propositions to the first and last sums and ratios of nascent and evanescent quantities, that is, to the limits of those sums and ratios; and so to premise, as short as I could, the demonstrations of those limits. For hereby the same thing is performed as by the method of indivisibles; and now those principles being demonstrated, we may use them with more safety.—Therefore, if hereafter I should happen to consider quantities as made of particles, or should use little curve lines for right ones; I would not be understood to mean indivisibles, but evanescent divisible quantities; not the sums and ratios of determinate parts, but always the limits of sums and ratios; and that the force of such demonstrations always depends on the method laid down in the foregoing lemmas.

"Perhaps it may be objected, that there is no ultimate proportion of evanescent quantities, because the proportion, before the quantities have vanished, is not the ultimate, and, when they are vanished, is none.—But by the same argument it may be alleged, that a body arriving at a certain place, and there stopping, has no ultimate velocity; because the velocity before the body comes to the place is not its ultimate velocity; when it is arrived, it has none. But the answer is easy: for by the ultimate velocity is meant that with which the body is moved, neither before it arrives at its place and the motion ceases, nor after; but at the very instant it arrives, that is, that velocity with which the body arrives at its last place, and with which the motion ceases. And in like manner, by the ultimate ratio of evanescent quantities is to be understood the ratio of the quantities, not before they vanish, nor afterwards, but with which they vanish. In like manner, the first ratio of nascent quantities is that with which they begin to be. And the first or last sum is that with which they begin and cease to be (or to be augmented and diminished). There is a limit which the velocity at the end of the motion may attain, but not exceed; and this is the ultimate velocity. And there is the like limit in all quantities and proportions that begin and cease to be. And, since such limits are certain and definite, to determine the same is a problem strictly geometrical. But whatever is geometrical we may be allowed to make use of in determining and demonstrating any other thing that is likewise geometrical.

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"It may also be objected, that if the ultimate ratios of evanescent quantities are given, their ultimate magnitudes will be also given; and so all quantities will consist of indivisibles, which is contrary to what Euclid has demonstrated concerning incommensurables, in the 10th book of his Elements. But this objection is founded on a false supposition. For those ultimate ratios with which quantities vanish are not truly the ratios of ultimate quantities, but limits towards which the ratios of quantities decreasing continually approach."

Plate CCCLXIX, fig. 1.

LEM. II. If in any figure A *a c* E terminated by the right line A *a*, A E, and the curve *a c* E, there be inscribed any number of parallelograms A *b*, B *c*, C *d*, &c. comprehended under equal bases AB, BC, CD, &c. and the sides B *b*, C *c*, D *d*, &c. parallel to one side A *a* of the figure; and the parallelograms *a* K *b l*, *b* L *c m*, *c* M *d n*, &c. are completed.—Then if the breadth of those parallelograms be supposed to be diminished, and their number augmented *in infinitum;* the ultimate ratios which the inscribed figure A K *b* L *c* M *d* D, the circumscribed figure A *a l b m c n d o* E, and curvilineal figure A *a b c d* E, will have to one another, are ratios of equality.—For the difference of the inscribed and circumscribed figures is the sum of the parallelograms K *l*, L *m*, M *n*, D *o*; that is (from the equality of all their bases), the rectangle under one of their bases K *b*, and the sum of their altitudes A *a*, that is, the rectangle AB *l a*.—But this rectangle, because its breadth AB is supposed diminished *in infinitum*, becomes less than any given space. And therefore by Lem. I. the figures inscribed and circumscribed become ultimately equal the one to the other; and much more will the intermediate curvilineal figure be ultimately equal to either.

LEM. III. The same ultimate ratios are also ratios of equality, when the breadths AB, BC, CD, &c. of the parallelograms are unequal, and are all diminished *in infinitum*.—The demonstration of this differs but little from that of the former.

In

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In his succeeding lemmas, Sir Isaac goes on to prove, in a manner similar to the above, that the ultimate ratios of the sine, chord, and tangent of arcs infinitely diminished, are ratios of equality, and therefore that in all our reasonings about these we may safely use the one for the other:—that the ultimate form of evanescent triangles made by the arc, chord, and tangent, is that of similitude, and their ultimate ratio is that of equality; and hence, in reasonings about ultimate ratios, we may safely use these triangles for each other, whether made with the sine, the arc, or the tangent.—He then shows some properties of the ordinates of curvilinear figures; and proves that the spaces which a body describes by any finite force urging it, whether that force is determinate and immutable, or is continually augmented or continually diminished, are, in the very beginning of the motion, one to the other in the duplicate ratio of the powers. And, lastly, Having added some demonstrations concerning the evanescence of angles of contact, he proceeds to lay down the mathematical part of his system, and which depends on the following theorems:

Theor. I. The areas which revolving bodies describe by radii drawn to an immoveable centre of force, lie in the same immoveable planes, and are proportional to the times in which they are described.—For, suppose the time to be divided into equal parts, and in the first part of that time, let the body by its innate force describe the right line AB (fig. 2.); in the second part of that time, the same would, by Law 1. if not hindered, proceed directly to c along the line B c=AB; so that by the radii AS, BS, c S, drawn to the centre, the equal areas ASB, BS c, would be described. But, when the body is arrived at B, suppose the centripetal force acts at once with a great impulse, and turning aside the body from the right line B c, compels it afterwards to continue its motion along the right line BC. Draw c C parallel to BS, meeting BC in C; and at the end of the second part of the time, the body, by Cor. 1. of the Laws, will be found in C, in the same plane with the triangle ASB. Join SC; and because SB and c C are parallel, the triangle SBC will be equal to the triangle SBC, and therefore also to the triangle SAB. By the like argument, if the centripetal force acts successively in C, D, E, &c. and makes the body in each single particle of time to describe the right lines CD, DE, EF, &c. they will all lie in the same plane; and the triangle SCD will be equal to the triangle SBC, and SDE to SCD, and SEF to SDE. And therefore, in equal times, equal areas are described in one immoveable plane; and, by composition, any sums SADS, SAFS, of those areas are, one to the other, as the times in which they are described. Now, let the number of those triangles be augmented, and their size diminished *in infinitum*; and then, by the preceding lemmas, their ultimate perimeter ADF will be a curve line: and therefore the centripetal force by which the body is perpetually drawn back from the tangent of this curve will act continually; and any described areas SADS, SAFS, which are always proportional to the times of description, will, in this case also, be proportional to those times. Q. E. D.

Fig. 2.

Cor. 1. The velocity of a body attracted towards an immoveable centre, in spaces void of resistance, is reciprocally as the perpendicular let fall from that centre on the right line which touches the orbit. For the velocities in these places, A, B, C, D, E, are as the bases AB, BC, DE, EF, of equal triangles; and these bases are reciprocally as the perpendiculars let fall upon them.

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Cor. 2. If the chords AB, BC, of two arcs, successively described in equal times by the same body, in spaces void of resistance, are completed into a parallelogram ABCV, and the diagonal BV of this parallelogram, in the position which it ultimately acquires when those arcs are diminished *in infinitum*, is produced both ways, it will pass through the centre of force.

Cor. 3. If the chords AB, BC, and DE, EF, of arcs described in equal times, in spaces void of resistance, are completed into the parallelograms ABCV, DEFZ, the forces in B and E are one to the other in the ultimate ratio of the diagonals BV, EZ, when those arcs are diminished *in infinitum*. For the motions BC and EF of the body (by Cor. 1. of the Laws), are compounded of the motions B c, BV and E f, EZ; but BV and EZ, which are equal to C c and F f, in the demonstration of this proposition, were generated by the impulses of the centripetal force in B and E, and are therefore proportional to those impulses.

Cor. 4. The forces by which bodies, in spaces void of resistance, are drawn back from rectilinear motions, and turned into curvilinear orbits, are one to another as the versed sines of arcs described in equal times; which versed sines tend to the centre of force, and bisect the chords when these arcs are diminished to infinity. For such versed sines are the halfs of the diagonals mentioned in Cor. 3.

Cor. 5. And therefore those forces are to the force of gravity, as the said versed sines to the versed sines perpendicular to the horizon of those parabolic arcs which projectiles describe in the same time.

Cor. 6. And the same things do all hold good (by Cor. 5. of the laws) when the planes in which the bodies are moved, together with the centres of force, which are placed in those planes, are not at rest, but move uniformly forward in right lines.

Theor. II. Every body that moves in any curve line described in a plane, and, by a radius drawn to a point either immoveable or moving forward with an uniform rectilinear motion, describes about that point areas proportional to the times, is urged by a centripetal force directed to that point.

Case I. For every body that moves in a curve line is (by Law 1.) turned aside from its rectilinear course by the action of some force that impels it; and that force by which the body is turned off from its rectilinear course, and made to describe in equal times the least equal triangles SAB, SBC, SCD, &c. about the immoveable point S, (by Prop. 40. E. 1. and Law 2.) acts in the place B according to the direction of a line parallel to C; that is, in the direction of the line BS; and in the place C according to the direction of a line parallel to d D, that is, in the direction of the line CS, &c.; and therefore acts always in the direction of lines tending to the immoveable point S. Q. E. D.

Case II. And (by Cor. 5. of the laws) it is indifferent whether the superficies in which a body describes a curvilinear figure be quiescent, or moves together with the body, the figure described, and its point S, uniformly forward in right lines.

Cor.

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Cor. 1. In non-resisting spaces or mediums, if the areas are not proportional to the times, the forces are not directed to the point in which the radii meet; but diviate therefrom *in consequentia*, or towards the parts to which the motion is directed, if the description of the areas is accelerated; but *in antecedentia* if retarded.

Cor. 2. And even in resisting mediums, if the description of the areas is accelerated, the directions of the forces deviate from the point in which the radii meet, towards the parts to which the motion tends.

Scholium.

A body may be urged by a centripetal force compounded of several forces. In which case the meaning of the proposition is, that the force which results out of all tends to the point S. But if any force acts perpetually in the direction of lines perpendicular to the described surface, this force will make the body to deviate from the plane of its motion, but will neither augment nor diminish the quantity of the described surface; and is therefore not to be neglected in the composition of forces.

Theor. III. Every body that, by a radius drawn to the centre of another body, howsoever moved, describes areas about that centre proportional to the times, is urged by a force compounded of the centripetal forces tending to that other body, and of all the accelerative force by which that other body is impelled.—The demonstration of this is a natural consequence of the theorem immediately preceding.

Hence, if the one body L, by a radius drawn to the other body T, describes areas proportional to the times, and from the whole force by which the first body L is urged, (whether that force is simple, or, according to Cor. 2. of the laws, compounded of several forces), we subduct that whole accelerative force by which the other body is urged; the whole remaining force by which the first body is urged will tend to the other body T, as its centre.

And *vice versa*, if the remaining force tends nearly to the other body T, those areas will be nearly proportional to the times.

If the body L, by a radius drawn to the other body T, describes areas, which, compared with the times, are very unequal, and that other body T be either at rest, or moves uniformly forward in a right line, the action of the centripetal force tending to that other body T is either none at all, or it is mixed and combined with very powerful actions of other forces; and the whole force compounded of them all, if they are many, is directed to another (immoveable or moveable) centre. The same thing obtains when the other body is actuated by any other motion whatever; provided that centripetal force is taken which remains after subducting that whole force acting upon that other body T.

Scholium.

Because the equable description of areas indicates that a centre is respected by that force with which the body is most affected, and by which it is drawn back from its rectilinear motion, and retained in its orbit, we may always be allowed to use the equable description of areas as an indication of a centre about which all circular motion is performed in free spaces.

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Theor. IV. The centripetal forces of bodies which by equable motions describe different circles, tend to the centres of the same circles; and are one to the other as the squares of the arcs described in equal times applied to the radii of circles.—For these forces tend to the centres of the circles, (by Theor. 2. and Cor. 2. Theor. 1.) and are to one another as the versed sines of the least arcs described in equal times (by Cor. 4. Theor 1.), that is, as the squares of the same arcs applied to the diameters of the circles, by one of the lemmas; and therefore, since those arcs are as arcs described in any equal times, and the diameters are as the radii, the forces will be as the squares of any arcs described in the same time, applied to the radii of the circles. Q. E. D.

Cor. 1. Therefore, since those arcs are as the velocities of the bodies, the centripetal forces are in a ratio compounded of the duplicate ratio of the velocities directly, and of the simple ratio of the radii inversely.

Cor. 2. And since the periodic times are in a ratio compounded of the ratio of the radii directly, and the ratio of the velocities inversely; the centripetal forces are in a ratio compounded of the ratio of the radii directly, and the duplicate ratio of the periodic times inversely.

Cor. 3. Whence, if the periodic times are equal, and the velocities therefore as the radii, the centripetal forces will be equal among themselves; and the contrary.

Cor. 4. If the periodic times and the velocities are both in the subduplicate ratio of the radii, the centripetal forces will be equal among themselves; and the contrary.

Cor. 5. If the periodic times are as the radii, and therefore the velocities equal, the centripetal forces will be reciprocally as the radii; and the contrary.

Cor. 6. If the periodic times are in the sesquiplicate ratio of the radii, and therefore the velocities reciproeally in the subduplicate ratio of the radii, the centripetal forces will be in the duplicate ratio of the radii inversely; and the contrary.

Cor. 7. And universally, if the periodic time is as any power R^n of the radius R, and therefore the velocity reciproeally as the power R^{n-1} of the radius, the centripetal force will be reciprocally as the power R^{2n-1} of the radius; and the contrary.

Cor. 8. The same things all hold concerning the times, the velocities, and forces, by which bodies describe the similar parts of any similar figures, that have their centres in a similar position within those figures, as appears by applying the demonstrations of the preceding cases to those. And the application is easy, by only substituting the equable description of areas in the place of equable motion, and using the distances of the bodies from the centres instead of the radii.

Cor. 9. From the same demonstration it likewise follows, that the arc which a body uniformly revolving in a circle by means of a given centripetal force describes in any time, is a mean proportional between the diameter of the circle, and the space which the same body, falling by the same given force, would descend through in the same given time.

"By

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"By means of the preceeding proposition and its corollaries (says Sir Isaac), we may discover the proportion of a centripetal force to any other known force, such as that of gravity. For if a body by means of its gravity revolves in a circle concentric to the earth, this gravity is the centripetal force of that body. But from the descent of heavy bodies, the time of one entire revolution, as well as the arc described in any given time, is given (by Cor. 9. of this theorem). And by such propositions Mr Huygens, in his excellent book *De Horologio Oscillatorio*, has compared the force of gravity with the centrifugal forces of revolving bodies.

The preceding proposition may also be demonstrated in the following manner. In any circle suppose a polygon to be inscribed of any number of sides. And if a body, moved with a given velocity along the sides of the polygon, is reflected from the circle at the several angular points; the force with which, at every reflection it strikes the circle, will be as its velocity: and therefore the sum of the forces, in a given time, will be as that velocity and the number of reflections conjunctly; that is (if the species of the polygon be given), as the length described in that given time, and increased or diminished in the ratio of the same length to the radius of the circle; that is, as the square of that length applied to the radius; and therefore, if the polygon, by having its sides diminished *in infinitum*, coincides with the circle, as the square of the arc described in a given time applied to the radius. This is the centrifugal force, with which the body impels the circle; and to which the contrary force, wherewith the circle continually repels the body towards the centre, is equal.

On these principles hangs the whole of Sir Isaac Newton's mathematical philosophy. He now shows how to find the centre to which the forces impelling any body are directed, having the velocity of the body given: and finds the centrifugal force to be always as the versed sine of the nascent arc directly, and as the square of the time inversely; or directly as the square of the velocity, and inversely as the chord of the nascent arc. From these premises he deduces the method of finding the centripetal force directed to any given point when the body revolves in a circle; and this whether the central point is near or at an immense distance; so that all the lines drawn from it may be taken for parallels. The same thing he shows with regard to bodies revolving in spirals, ellipses, hyperbolas, or parabolas.—Having the figures of the orbits given, he shows also how to find the velocities and moving powers; and, in short, solves all the most difficult problems relating to the celestial bodies with an astonishing degree of mathematical skill. These problems and demonstrations are all contained in the first book of the *Principia*: but to give an account of them here would far exceed our limits; neither would many of them be intelligible, excepting to first-rate mathematicians.

16 Rules for philosophical reasoning.

In the second book, Sir Isaac treats of the properties of fluids, and their powers of resistance: and here he lays down such principles as entirely overthrow the doctrine of Des Cartes's vortices, which was the fashionable system in his time. In the third book, he begins particularly to treat of the natural phenomena, and apply them to the mathematical principles formerly demonstrated; and, as a necessary preliminary to this part, he lays down the following rules for reasoning in natural philosophy. Newtonian Philosophy.

1. We are to admit no more causes of natural things than such as are both true and sufficient to explain their natural appearances.

2. Therefore to the same natural effects we must always assign, as far as possible, the same causes.

3. The qualities of bodies which admit neither intension or remission of degrees, and which are found to belong to all bodies within the reach of our experiments, are to be esteemed the universal qualities of all bodies whatsoever.

4. In experimental philosophy, we are to look upon propositions collected by general induction from phenomena as accurately or very nearly true, notwithstanding any contrary hypotheses that may be imagined, till such time as other phenomena occur, by which they may either be made more accurate, or liable to exceptions.

The phenomena first considered are, 1. That the satellites of Jupiter, by radii drawn to the centre of their primary, describe areas proportional to the times of their description; and that their periodic times, the fixed stars being at rest, are in the sesquiplicate ratio of their distances from its centre. 2. The same thing is likewise observed of the phenomena of Saturn. 3. The five primary planets, Mercury, Venus, Mars, Jupiter, and Saturn, with their several orbits encompass the sun. 4. The fixed stars being supposed at rest, the periodic times of the five primary planets, and of the earth, about the sun, are in the sesquiplicate proportion of their mean distances from the sun. 5. The primary planets, by radii drawn to the earth, describe areas no ways proportionable to the times: but the areas which they describe by radii drawn to the sun are proportional to the times of description. 6. The moon, by a radius drawn to the centre of the earth, describes an area proportional to the time of description. All these phenomena are undeniable from astronomical observations, and are explained at large under the article Astronomy. The mathematical demonstrations are next applied by Sir Isaac Newton in the following propositions:

Prop. I. The forces by which the satellites of Jupiter are continually drawn off from rectilinear motions, and retained in their proper orbits, tend to the centre of that planet; and are reciprocally as the squares of the distances of those satellites from that centre. The former part of this proposition appears from Theor. 2. or 3. and the latter from Cor. 6. of Theor. 5.; and the same thing we are to understand of the satellites of Saturn.

Prop. II. The forces by which the primary planets are continually drawn off from rectilinear motions, and retained in their proper orbits, tend to the sun; and are reciprocally as the squares of the distances from the sun's centre. The former part of this proposition is manifest from Phenomenon 5. just mentioned, and from Theor. 2.; the latter from Phenomenon 4. and Cor. 6. of Theor. 4. But this part of the proposition is with great accuracy deducible from the quiescence of the aphelion points. For a very small aberration from the reciprocal duplicate proportion would produce a motion of the apsides, sensible in every single revolution, and in many of them enormously great.

Prop. III. The force by which the moon is retained

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in its orbit, tends towards the earth; and is reciprocally as the square of the distance of its place from the centre of the earth. The former part of this proposition is evident from Phenom. 5. and Theor. 2.; the latter from Phenom. 6. and Theor. 2. or 3. It is also evident from the very slow motion of the moon's apogee; which, in every single revolution, amounting but to $3^{\circ}\ 3'$ *in consequentia*, may be neglected: and this more fully appears from the next proposition.

PROP. IV. The moon gravitates towards the earth, and by the force of gravity is continually drawn off from a rectilinear motion, and retained in its orbit.—The mean distance from the moon to the earth in the syzigies, in semidiameters of the latter, is about $60\frac{1}{2}$. Let us assume the mean distance of 60 semidiameters in the syzigies; and suppose one revolution of the moon in respect of the fixed stars to be completed in $27^{d}\ 7^{h}\ 43'$, as astronomers have determined; and the circumference of the earth to amount to 123,249,600 Paris feet. Now, if we imagine the moon, deprived of all motion, to be let go, so as to descend towards the earth with the impulse of all that force by which it is retained in its orbit, it will, in the space of one minute of time, describe in its fall $15\frac{1}{4}$ Paris feet. For the versed sine of that arc which the moon, in the space of one minute of time, describes by its mean motion at the distance of 60 semidiameters of the earth, is nearly $15\frac{1}{12}$ Paris feet; or more accurately, 15 feet one inch and one line $\frac{4}{9}$. Wherefore since that force, in approaching to the earth, increases in the reciprocal duplicate proportion of the distance; and, upon that account, at the surface of the earth, is 60×60 times greater than that at the moon; a body in our regions, falling with that force, ought, in the space of one minute of time, to describe $60 \times 60 \times 15\frac{1}{12}$ Paris feet; and in the space of one second of time to describe $15\frac{1}{12^2}$ of those feet; or, more accurately, 15 feet 1 inch 1 line $\frac{4}{9}$. And with this very force we actually find that bodies here on earth do really descend.—For a pendulum oscillating seconds in the latitude of Paris, will be three Paris feet and $8\frac{1}{2}$ lines in length, as Mr Huygens has observed. And the space which a heavy body describes by falling one second of time, is to half the length of the pendulum in the duplicate ratio of the circumference of the circle to its diameter; and is therefore 15 Paris feet 1 inch 1 line $\frac{7}{9}$. And therefore the force by which the moon is retained in its orbit, becomes at the very surface of the earth, equal to the force of gravity which we observe in heavy bodies there. And therefore (by Rule 1. and 2.) the force by which the moon is retained in its orbit is that very same force which we commonly call *gravity*. For were gravity another force different from that, then bodies descending to the earth with the joint impulse of both forces would fall with a double velocity, and, in the space of one second of time, would describe $30\frac{1}{6}$ Paris feet; altogether against experience.

The demonstration of this proposition may be more diffusely explained after the following manner: Suppose several moons to revolve about the earth, as in the system of Jupiter or Saturn, the periodic times of those moons would (by the argument of induction) observe the same law which Kepler found to obtain among the planets; and therefore their centripetal forces would be reciprocally as the squares of the distances from the centre of the earth, by Prop. I. Now, if the lowest of these were very small, and were so near the earth as almost to touch the tops of the highest mountains, the centripetal force thereof, retaining it in its orbit, would be very nearly equal to the weights of any terrestrial bodies that should be found upon the tops of these mountains; as may be known from the foregoing calculation. Therefore, if the same little moon should be deserted by its centrifugal force that carries it through its orbit, it would descend to the earth; and that with the same velocity as heavy bodies do actually descend with upon the tops of those very mountains, because of the equality of forces that oblige them both to descend. And if the force by which that lowest moon would descend were different from that of gravity, and if that moon were to gravitate towards the earth, as we find terrestrial bodies do on the tops of mountains, it would then descend with twice the velocity, as being impelled by both these forces conspiring together. Therefore, since both these forces, that is, the gravity of heavy bodies, and the centripetal forces of the moons, respect the centre of the earth, and are similar and equal between themselves, they will (by Rule 1. and 2.) have the same cause. And therefore the force which retains the moon in its orbit, is that very force which we commonly call *gravity;* because otherwise, this little moon at the top of a mountain must either be without gravity, or fall twice as swiftly as heavy bodies use to do.

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Having thus demonstrated that the moon is retained in its orbit by its gravitation towards the earth, it is easy to apply the same demonstration to the motions of the other secondary planets, and of the primary planets round the sun, and thus to show that gravitation prevails throughout the whole creation; after which, Sir Isaac proceeds to show from the same principles that the heavenly bodies gravitate towards each other, and contain different quantities of matter, or have different densities in proportion to their bulks.

PROB. V. All bodies gravitate towards every planet; and the weights of bodies towards the same planet, at equal distances from its centre, are proportional to the quantities of matter they contain.

It has been confirmed by many experiments, that all sorts of heavy bodies (allowance being made for the inequality of retardation by some small resistance of the air), descend to the earth from equal heights in equal times; and that equality of times we may distinguish to a great accuracy by the help of pendulums. Sir Isaac Newton tried the thing in gold, silver, lead, glass, sand, common salt, wood, water, and wheat. He provided two wooden boxes, round and equal, filled the one with wood, and suspended an equal weight of gold in the centre of oscillation of the other. The boxes hanging by equal threads of 11 feet, made a couple of pendulums, perfectly equal in weight and figure, and equally receiving the resistance of the air. And placing the one by the other, he observed them to play together forwards and backward, for a long time, with equal vibrations. And therefore the quantity of matter in the gold was to the quantity of matter in the wood, as the action of the motive force (or *vis motrix*) upon all the gold, to the action of the same upon all the wood; that is, as the

weight

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weight of the one to the weight of the other. And the like happened in the other bodies. By these experiments, in bodies of the same weight, he could manifestly have discovered a difference of matter less than the thousandth part of the whole, had any such been. But without all doubt, the nature of gravity towards the planets, is the same as towards the earth. For should we imagine our terrestrial bodies removed to the orb of the moon, and there, together with the moon, deprived of all motion, to be let go, so as to fall together towards the earth; it is certain from what we have demonstrated before, that in equal times, they would describe equal spaces with the moon, and of consequence are to the moon in quantity of matter, as their weights to its weight. Moreover, since the satellites of Jupiter perform their revolutions in times which observe the sesquiplicate proportion of their distances from Jupiter's centre, their accelerative gravities towards Jupiter will be reciprocally as the squares of their distances from Jupiter's centre; that is, equal at equal distances. And therefore, these satellites, if supposed to fall towards Jupiter from equal heights, would describe equal spaces in equal times, in like manner as heavy bodies do on our earth. And by the same argument if the circumsolar planets were supposed to be let fall at equal distances from the sun, they would, in their descent towards the sun, describe equal spaces in equal times. But forces, which equally accelerate unequal bodies, must be as those bodies: that is to say, the weights of the planets towards the sun must be as their quantities of matter. Further, That the weights of Jupiter and his satellites towards the sun are proportional to the several quantities of their matter, appears from the exceeding regular motions of the satellites. For if some of the bodies were more strongly attracted to the sun in proportion to their quantity of matter than others, the motions of the satellites would be disturbed by that inequality of attraction. If, at equal distances from the sun, any satellite, in proportion to the quantity of its matter, did gravitate towards the sun, with a force greater than Jupiter in proportion to his, according to any given proportion, suppose d to e; then the distance between the centres of the sun and of the satellite's orbit would be always greater than the distance between the centres of the sun and of Jupiter nearly in the subduplicate of that proportion. And if the satellite gravitated towards the sun with a force less in the proportion of e to d, the distance of the centre of the satellite's orb from the sun would be less than the distance of the centre of Jupiter's from the sun in the subduplicate of the same proportion. Therefore, if, at equal distances from the sun, the accelerative gravity of any satellite towards the sun were greater or less than the accelerating gravity of Jupiter towards the sun but by $\frac{1}{1000}$ part of the whole gravity; the distance of the centre of the satellite's orbit from the sun would be greater or less than the distance of Jupiter from the sun by $\frac{1}{2000}$ part of the whole distance; that is, by a fifth part of the distance of the utmost satellite from the centre of Jupiter; an eccentricity of the orbit which would be very sensible. But the orbits of the satellites are concentric to Jupiter; therefore the accelerative gravities of Jupiter, and of all its satellites, towards the sun, are equal among themselves. And by the same argument, the weight of Saturn and of his satellites towards the sun, at equal distances from the sun, are as their several quantities of matter; and the weights of the moon and of the earth towards the sun, are either none, or accurately proportional to the masses of matter which they contain. Newtonian Philosophy.

But further, the weights of all the parts of every planet towards any other planet are one to another as the matter in the several parts. For if some parts gravitated more, others less, than in proportion to the quantity of their matter; then the whole planet, according to the sort of parts with which it most abounds, would gravitate more or less than in proportion to the quantity of matter in the whole. Nor is it of any moment whether these parts are external or internal. For if, as an instance, we should imagine the terrestrial bodies with us to be raised up to the orb of the moon, to be there compared with its body; if the weights of such bodies were to the weights of the external parts of the moon as the quantities of matter in the one and in the other respectively, but to the weights of the internal parts in a greater or less proportion; then likewise the weights of those bodies would be to the weight of the whole moon in a greater or less proportion; against what we have showed above.

Cor. 1. Hence the weights of bodies do not depend upon their forms and textures. For if the weights could be altered with the forms, they would be greater or less, according to the variety of forms in equal matter; altogether against experience.

Cor. 2. Universally, all bodies about the earth gravitate towards the earth; and the weights of all, at equal distances from the earth's centre, are as the quantities of matter which they severally contain. This is the quality of all bodies within the reach of our experiments; and therefore (by Rule 3.) to be affirmed of all bodies whatsoever. If ether, or any other body, were either altogether void of gravity, or were to gravitate less in proportion to its quantity of matter; then, because (according to Aristotle, Des Cartes, and others) there is no difference betwixt that and other bodies, but in mere form of matter, by a successive change from form to form, it might be changed at last into a body of the same condition with those which gravitate most in proportion to their quantity of matter; and, on the other hand, the heaviest bodies, acquiring the first form of that body, might by degrees quite lose their gravity. And therefore the weights would depend upon the forms of bodies, and with those forms might be changed, contrary to what was proved in the preceding corollary.

Cor. 3. All spaces are not equally full. For if all spaces were equally full, then the specific gravity of the fluid which fills the region of the air, on account of the extreme density of the matter, would fall nothing short of the specific gravity of quicksilver or gold, or any other the most dense body, and therefore, neither gold, nor any other body, could descend in air. For bodies do not descend in fluids, unless they are specifically heavier than the fluids. And if the quantity of matter in a given space can by any rarefaction be diminished, what should hinder a diminution to infinity?

Cor. 4. If all the solid particles of all bodies are of the same density, nor can be rarefied without pores, a void space or vacuum must be granted. [By bodies

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of the same density, our author means those whose *vires inertiæ* are in the proportion of their bulks.]

Prob. VI. That there is a power of gravity tending to all bodies, proportional to the several quantities of matter which they contain.

That all the planets mutually gravitate one towards another, we have proved before: as well as that the force of gravity towards every one of them, considered apart, is reciprocally as the square of the distance of places from the centre of the planet. And thence it follows that the gravity tending towards all the planets is proportional to the matter which they contain.

Moreover, since all the parts of any planet A gravitate towards any other planet B, and the gravity of every part is to the gravity of the whole as the matter of the part to the matter of the whole; and (by Law 3.) to every action corresponds an equal re-action: therefore the planet B will, on the other hand, gravitate towards all the parts of the planet A; and its gravity towards any one part will be to the gravity towards the whole, as the matter of the part to the matter of the whole. Q. E. D.

Cor. 1. Therefore the force of gravity towards any whole planet, arises from, and is compounded of, the forces of gravity towards all its parts. Magnetic and electric attractions afford us examples of this. For all attraction towards the whole arises from the attractions towards the several parts. The thing may be easily understood in gravity, if we consider a greater planet as formed of a number of lesser planets, meeting together in one globe. For hence it would appear that the force of the whole must arise from the forces of the component parts. If it be objected, that, according to this law, all bodies with us must mutually gravitate one towards another, whereas no such gravitation anywhere appears; it is answered, that, since the gravitation towards these bodies is to the gravitation towards the whole earth, as these bodies are to the whole earth, the gravitation towards them must be far less than to fall under the observation of our senses. [The experiments with regard to the attraction of mountains, however, have now further elucidated this point.]

Cor. 2. The force of gravity towards the several equal particles of any body, is reciprocally as the square of the distance of places from the particles.

Prob. VII. In two spheres mutually gravitating each towards the other, if the matter, in places on all sides round about and equidistant from the centres, is similar; the weight of either sphere towards the other will be reciprocally as the square of the distance between their centres.

For the demonstration of this, see the *Principia*, Book I. Prop. lxxv. and lxxvi.

Cor. 1. Hence we may find and compare together the weights of bodies towards different planets. For the weights of bodies revolving in circles about planets are as the diameters of the circles directly, and the squares of their periodic times reciprocally; and their weights at the surfaces of the planets, or at any other distances from their centres, are (by this prop.) greater or less, in the reciprocal duplicate proportion of the distances. Thus from the periodic times of Venus, revolving about the sun, in 224d. $16\frac{3}{4}$h.; of the outmost circumjovial satellite revolving about Jupiter, in 16d. $16\frac{8}{15}$h.; of the Huygenian satellite about Saturn in 15d. $22\frac{2}{3}$h.; and of the moon about the earth in 27d. 7h. 43′; compared with the mean distance of Venus from the sun, and with the greatest heliocentric elongations of the outmost circumjovial satellite from Jupiter's centre, 8′ 16″; of the Huygenian satellite from the centre of Saturn, 3′ 4″; and of the moon from the earth, 10′ 33″; by computation our author found, that the weight of equal bodies, at equal distances from the centres of the sun, of Jupiter, of Saturn, and of the earth, towards the sun, Jupiter, Saturn, and the earth, were one to another as $\frac{1}{1067}$, $\frac{1}{3021}$, and $\frac{1}{169282}$ respectively. Then, because as the distances are increased or diminished, the weights are diminished or increased in a duplicate ratio; the weights of equal bodies towards the sun, Jupiter, Saturn, and the earth, at the distances 10000, 997, 791, and 109, from their centres, that is, at their very superficies, will be as 10000, 943, 529, and 435 respectively.

Cor. 2. Hence likewise we discover the quantity of matter in the several planets. For their quantities of matter are as the forces of gravity at equal distances from their centres, that is, in the sun, Jupiter, Saturn, and the earth, as 1, $\frac{1}{1067}$, $\frac{1}{3021}$, and $\frac{1}{169282}$, respectively. If the parallax of the sun be taken greater or less than 10″ 30‴, the quantity of matter in the earth must be augmented or diminished in the triplicate of that proportion.

Cor. 3. Hence also we find the densities of the planets. For (by Prop. lxxii. Book I.) the weights of equal and similar bodies towards similar spheres, are, at the surfaces of those spheres, as the diameters of the spheres. And therefore the densities of dissimilar spheres are as those weights applied to the diameters of the spheres. But the true diameters of the sun, Jupiter, Saturn, and the earth, were one to another as 10000, 997, 791, and 109; and the weights towards the same, as 10000, 943, 529, and 435 respectively; and therefore their densities are as 120, $94\frac{1}{2}$, 67, and 400. The density of the earth, which comes out by this computation, does not depend upon the parallax of the sun, but it is determined by the parallax of the moon, and therefore is here truly defined. The sun therefore is a little denser than Jupiter, and Jupiter than Saturn, and the earth four times denser than the sun; for the sun, by its great heat, is kept in a sort of a rarefied state. The moon also is denser than the earth.

Cor. 4. The smaller the planets are, they are *cæteris paribus*, of so much the greater density. For so the powers of gravity on their several surfaces come nearer to equality. They are likewise, *cæteris paribus*, of the greater density as they are nearer to the sun. So Jupiter is more dense than Saturn, and the earth than Jupiter. For the planets were placed at different distances from the sun, that, according to their degrees of density, they might enjoy a greater or less proportion of the sun's heat. Our water, if it were removed as far as the orb of Saturn, would be converted into ice, and in the orb of Mercury would quickly fly away in vapour. For the light of the sun, to which its heat is proportional, is seven times denser in the orb of Mercury than with us: and by the thermometer Sir Isaac found, that a sevenfold heat of our summer sun will make water boil. Nor are we to doubt,

that

Newtonian Philosophy, Newton.

that the matter of Mercury is adapted to its heat, and is therefore more dense than the matter of our earth; since, in a denser matter, the operations of nature require a stronger heat.

It is shown in the scholium of Prop. xxii. Book II. of the *Principia*, that, at the height of 200 miles above the earth, the air is more rare than it is at the superficies of the earth, in the ratio of 30 to 0,000000000003998, or as 75,000000000000 to 1 nearly. And hence the planet Jupiter, revolving in a medium of the same density with that superior air, would not lose by the resistance of the medium the 1000000th part of its motion in 1000000 years. In the spaces near the earth, the resistance is produced only by the air, exhalations, and vapours. When these are carefully exhausted by the air pump from under the receiver, heavy bodies fall within the receiver with perfect freedom, and without the least sensible resistance; gold itself, and the lightest down, let fall together, will descend with equal velocity; and though they fall through a space of four, six, and eight feet, they will come to the bottom at the same time; as appears from experiments that have often been made. And therefore the celestial regions being perfectly void of air and exhalations, the planets and comets meeting no sensible resistance in those spaces, will continue their motions through them for an immense space of time.

NEWTON, *Thomas*, lord bishop of Bristol and dean of St Paul's London, was born on the first of January 1704. His father, John Newton, was a considerable brandy and cyder merchant, who, by his industry and integrity, having acquired what he thought a competent fortune, left off trade several years before he died.

He received the first part of his education in the free school of Litchfield; a school which, the bishop observes with some kind of exultation, had at all times sent forth several persons of note and eminence; from Bishop Smaldridge and Mr Wollaston, to Dr Johnson and Mr Garrick

From Litchfield he was removed to Westminster school, in 1717, under the care of Dr Freind and Dr Nicoll.

During the time he was at Westminster, there were, he observes, more young men who made a distinguished figure afterwards in the world, than perhaps at any other period, either before or since. He particularly mentions William Murray, the late earl of Mansfield, with whom he lived on terms of the highest friendship to the last.

He continued six years at Westminster school, five of which he passed in the college. He afterwards went to Cambridge, and entered at Trinity college. Here he constantly resided eight months at least in every year, till he had taken his Bachelor of Arts degree. Being chosen fellow of his college, he came afterwards to settle in London. As it had been his inclination from a child, and as he was also designed for holy orders, he had sufficient time to prepare himself, and composed some sermons, that he might have a stock in hand when he entered on the ministry. His title for orders was his fellowship; and he was ordained deacon in December 1729, and priest in February following, by Bishop Gibson.

At his first setting out in his office, he was curate at St George's Hanover-square; and continued for several years assistant preacher to Dr Trebeck. His first preferment was that of reader and afternoon preacher at Grosvenor Chapel, in South Audley street. Newton.

This introduced him to the family of Lord Tyrconnel, to whose son he became tutor. He continued in this situation for many years, very much at his ease, and on terms of great intimacy and friendship with Lord and Lady Tyrconnel, "without so much (says he) as an unkind word or a cool look intervening."

In the spring of 1744, he was, through the interest of the earl of Bath (who was his great friend and patron, and whose friendship and patronage were returned by grateful acknowledgements and the warmest encomiums), presented to the rectory of St Mary Le Bow; so that he was 40 years old before he obtained any living.

At the commencement of 1745, he took his doctor's degree. In the spring of 1747 he was chosen lecturer of St George's, Hanover-square, by a most respectable vestry of noblemen and gentlemen of high distinction. In August following he married his first wife, the eldest daughter of Dr Trebeck; an unaffected, modest, decent young woman, with whom he lived very happy in mutual love and harmony for near seven years.

In 1749 he published his edition of Milton's Paradise Lost, which, (says he, very modestly) it is hoped hath not been ill received by the public, having, in 1775, gone through eight editions. After the Paradise Lost, it was judged (says he) proper that Dr Newton should also publish the Paradise Regained, and other poems of Milton; but these things he thought detained him from other more material studies, though he had the good fortune to gain by them more than Milton did by all his works put together. But his greatest gain (he says) was their first introducing him to the friendship and intimacy of two such men as Bishop Warburton and Dr Jortin, whose works will speak for them better than any private commendation.

In 1754 he lost his father at the age of 83; and within a few days his wife, at the age of 38. This was the severest trial he ever underwent, and almost overwhelmed him. At that time he was engaged in writing his Dissertations on the Prophecies; and happy it was for him: for in any affliction he never found a better or more effectual remedy than plunging deep into study, and fixing his thoughts as intensely as he possibly could upon other subjects. The first volume was published the following winter; but the other did not appear till three years afterwards; and as a reward for his past and an incitement to future labours, he was appointed, in the mean time, to preach Boyle's lecture. The bishop informs us, that 1250 copies of the Dissertations were taken at the first impression, and 1000 at every other edition: and "though (says he) some things have been since published upon the same subjects, yet, they still hold up their head above water, and having gone through five editions, are again prepared for another. Abroad, too, their reception hath not been unfavourable, if accounts from thence may be depended upon." They were translated into the German and Danish languages; and received the warmest encomiums from persons of learning and rank.

In the spring of 1757, he was made prebendary of Westminster, in the room of Dr Green, and promoted

Newton || Nexi.

to the deanery of Salisbury. In October following, he was made sub-almoner to his majesty. This he owed to Bishop Gilbert. He married a second wife in September 1761. She was the widow of the Rev. Mr Hand, and daughter of John Lord Viscount Lisburn. In the same month he kissed his majesty's hand for his bishopric.

In the winter of 1764, Dr Stone, the primate of Ireland, died. Mr Grenville sent for Bishop Newton, and in the most obliging manner desired his acceptance of the primacy. Having maturely weighed the matter in his mind, he declined the offer.

In 1768 he was made dean of St Paul's. His ambition was now fully satisfied; and he firmly resolved never to ask for any thing more.

From this time to his death, ill health was almost his constant companion. It was wonderful that such a poor, weak, and slender thread as the bishop's life, should be spun out to such an amazing length as it really was. In the autumn of 1781 (usually the most favourable part of the year to him) he laboured under repeated illnesses: and on Saturday the 9th of February 1782, he began to find his breath much affected by the frost. His complaints grew worse and worse till the Thursday following. He got up at five o'clock, and was placed in a chair by the fire; complained to his wife how much he had suffered in bed, and repeated to himself that portion of the Psalms, "O my God, I cry unto thee in the day time," &c. &c. About six o'clock he was left by his apothecary in a quiet sleep. Between seven and eight he awoke, and appeared rather more easy, and took a little refreshment. He continued dozing till near nine, when he ordered his servant to come and dress him, and help him down stairs. As soon as he was dressed, he inquired the hour, and bid his servant open the shutter and look at the dial of St Paul's. The servant answered, it was upon the stroke of nine. The bishop made an effort to take out his watch; with an intent to set it; but sunk down in his chair, and expired without a sigh or the least visible emotion, his countenance still retaining the same placid appearance which was so peculiar to him when alive. Of his numerous works, his Dissertations on the Prophecies are by much the most valuable. His learning was undoubtedly very considerable; but he seldom exhibits evidence of a very vigorous mind. On one occasion, indeed, he appears to have thought with freedom; for we believe he was the first dignitary of the church of England who avowed his belief of the final restitution of all things to harmony and happiness.

NEWTYA, a port little known, on the coast between Goa the capital of the Portuguese settlements in India, and the English settlement of Bombay. Mr Rennel conjectures it to be the *Nitrias* of Pliny; near which the pirates cruized for the Roman ship. The same writer places it near to 15° 52′ 30″ north latitude, and 73° 16′ 30″ east longitude.

NEXI, among the Romans, persons free born, who for debt were reduced to a state of slavery. By the laws of the twelve tables it was ordained, that insolvent debtors should be given up to their creditors to be bound in fetters and cords, whence they were called *Nexi*; and though they did not entirely lose the rights of freemen, yet they were often treated more harshly than the slaves themselves. If any one was indebted to several persons, and could not within 60 days find a cautioner, his body according to some, but according to others his effects, might be cut in pieces, and divided among his creditors. The latter opinion seems by much the most probable, as Livy mentions a law by which creditors had a right to attach the goods but not the persons of their debtors.

Nexi || Ngo-kia.

NEYTRECHT, a town of Upper Hungary, capital of a county of the same name, with a bishop's see; seated on the river *Neitra*, 40 miles north-east of Presburg. E. Long. 17. 49. N. Lat. 48. 28.

NGAN-KING-FOU, a city of China, and capital of the western part of the province of Kiang-nan. It is governed by a particular viceroy, who keeps a large garrison in a fort built on the banks of the river Yang-tse-kiang. Its situation is delightful; its commerce and riches render it very considerable; and every thing that goes from the southern part of China to Nan-king must pass through it. All the country belonging to it is level, pleasant, and fertile. It has under its jurisdiction only six cities of the third class.

NGO-KIA, a Chinese drug, of which the composition will no doubt appear as singular as the numerous properties ascribed to it. In the province Chang-tong, near Ngo-hien, a city of the third class, is a well formed by nature, which is reckoned to be seventy feet in depth, and which has a communication, as the Chinese say, with some subterranean lake, or other large reservoir. The water drawn from it is exceedingly clear, and much heavier than common; and if it be mixed with muddy water, it purifies it and renders it limpid, by precipitating all its impurities to the bottom of the vessel. This water is employed in making the ngo-kia, which is nothing else but a kind of glue procured from the skin of a black ass.

The animal is killed and flayed, and the skin is steeped for five days in water drawn from this well. At the end of that time, it is taken out to be scraped and cleaned; it is afterwards cut into small pieces, which are boiled over a slow fire, in the same kind of water, until it is reduced to a jelly, which is strained, while warm, through a cloth, to free it from all the gross matter which could not be melted. When this glue is cool, and has acquired a consistence, it is formed into square cakes, upon which the Chinese imprint characters and coats of arms, or the signs of their shops.

This well is the only one of the kind in China; it is always shut, and sealed by the governor of the place with his own seal, until the customary day of making the emperor's glue. This operation generally lasts from the autumnal harvest till the month of March. During that time, the neighbouring people and merchants treat for the purchase of the glue with those who guard the well, and with the people who make it. The latter manufacture as much of it as they can, on their own account, with this difference, that it is not so pure, and that they are less scrupulous in examining whether the ass be fat, or of a very black colour: however, all the glue made here is as much esteemed at Peking as that which the mandarins who are on the spot transmit to court and to their friends.

As this drug is in the greatest request, and as the quantity of it made at Ngo-hien is not sufficient to

Ngo-kio, Niagara.

supply the whole empire, there are not wanting people who counterfeit it elsewhere, and who manufacture a spurious kind from the skins of mules, horses, and camels, and sometimes even from old boots; it is, however, very easy to distinguish that which is genuine; it has neither a bad smell nor a disagreeable taste when applied to the mouth; it is brittle and friable, and always of a deep black colour, sometimes inclining to red. The qualities of the counterfeit kind are entirely different; both its taste and smell are disagreeable, and it is viscous and flabby even when made of the skin of a hog, which is that which imitates the true kind the best.

The Chinese attribute a great number of virtues to this drug. They assure us that it dissolves phlegm, facilitates the play and elasticity of the lungs, gives a free respiration to those who breathe with difficulty; that it comforts the breast, increases the blood, stops dysenteries, provokes urine, and strengthens children in the womb. Without warranting the truth of all these properties, it appears, at least, certain, by the testimony of the missionaries, that this drug is serviceable in all diseases of the lungs. It is taken with a decoction of simples, and sometimes in powder, but very seldom.

NIAGARA, a fort of North America, which was taken from the French in 1759. According to the treaty of 1794, it was delivered up by Britain to the United States in 1796. It is situated on a small peninsula formed by the river Niagara as it flows into the lake Ontario. About six leagues from the fort is the greatest cataract in the world, known by the name of the *Waterfall of Niagara*. The river at this fall runs from SSE to NNW; and the rock of the fall crosses it not in a right line, but forms a kind of figure like a hollow semicircle or horse shoe. Above the fall, in the middle of the river, is an island about 800 or 1000 feet long; the lower end of which is just at the perpendicular edge of the fall. On both sides of this island runs all the water that comes from the lakes of Canada; viz. Lake Superior, Lake Michigan, Lake Huron, and Lake Erie, which have some large rivers that open themselves into them. Before the water comes to this island, it runs but slowly compared with its motion afterwards, when it grows the most rapid in the world, running with a surprising swiftness before it comes to the fall. It is perfectly white, and in many places is thrown high up into the air. The water that runs down on the west side is more rapid, in greater abundance, and whiter, than that on the east side; and seems almost to outfly an arrow in swiftness. When you are at the fall, and look up the river, you may see that the water is everywhere exceedingly steep, almost like the side of a hill; but when you come to look at the fall itself, it is impossible to express the amazement it occasions. The height of it, as measured by mathematical instruments, is found to be exactly 137 feet; and when the water is come to the bottom, it jumps back to a very great height in the air. The noise may be heard at the distance of 45 miles, but seldom further; nor can it be heard even at Fort Niagara, which is only six leagues distant, unless Lake Ontario is calm. At that fort it is observed, that when they hear the noise of the fall more loud than ordinary, they are sure that a north-east wind will follow; which is the more surprising, as the fort lies south-west from the fall. At some times the fall makes a much greater noise than at others; and this is held for an infallible sign of approaching rain or other bad weather. Niagara.

From the place where the water falls there arises abundance of vapour like very thick smoke, insomuch that when viewed at a distance you would think that the Indians had set the forests on fire. These vapours rise high in the air when it is calm, but are dispersed by the wind when it blows hard. If you go into this vapour or fog, or if the wind blows it on you, it is so penetrating, that in a few moments you will be as wet as if you had been under water. Some are of opinion that when birds come flying into this fog or smoke of the fall, they drop down and perish in the water; either because their wings are become wet, or that the noise of the fall, astonishes them, and they know not where to go in the darkness: but others think that seldom or never any bird perishes there in that manner; because among the abundance of birds found dead below the fall, there are no other sorts than such as live and swim frequently in the water; as swans, geese, ducks, water hens, teal, and the like. And very often great flocks of them are seen going to destruction in this manner: they swim in the river above the fall, and so are carried down lower and lower by the water; and as water fowl commonly take great delight in being carried with the stream, they indulge themselves in enjoying this pleasure so long, till the swiftness of the water becomes so great, that it is no longer possible for them to rise, but they are driven down the precipice and perish. They are observed, when they draw nigh the fall, to endeavour with all their might to take wing and leave the water; but they cannot. In the months of September and October such abundant quantities of dead water fowl are found every morning below the fall, on the shore, that the garrison of the fort for a long time live chiefly upon them. Besides the fowl, they find also several sorts of dead fish, also deer, bears and other animals which have tried to cross the water above the fall; the larger animals are generally found broken to pieces. Just below, a little way from the fall, the water is not rapid, but goes all in circles, and whirls like a boiling pot; which however does not hinder the Indians going upon it in small canoes a-fishing; but a little further, and lower, the other smaller falls begin. When you are above the fall, and look down, your head begins to turn; even such as have been here numberless times, will seldom venture to look down, without at the same time keeping fast hold of some tree with one hand.

It was formerly thought impossible for anybody living to come at the island that is in the middle of the fall; but an accident that happened about 50 years ago made it appear otherwise. The history is this: Two Indians of the Six Nations went out from Niagara fort to hunt upon an island that is in the middle of the river, or strait, above the great fall, on which there used to be abundance of deer. They took some French brandy with them from the fort, which they tasted several times as they were going over the carrying place; and when they were in their canoe, they took now and then a dram, and so went along up the strait towards the island where they proposed

to

Niagara. to hunt; but growing sleepy, they laid themselves down in the canoe, which getting loose drove back with the stream, farther and farther down, till it came nigh that island that is in the middle of the fall. Here one of them, awakened by the noise of the fall, cries out to the other, that they were gone: Yet they tried if possible to save life. This island was nighest, and with much working they got on shore there. At first they were glad; but when they had considered every thing, they thought themselves hardly in a better state than if they had gone down the fall, since they had now no other choice, than either to throw themselves down the same, or perish with hunger. But hard necessity put them on invention. At the lower end of the island the rock is perpendicular, and no water is running there. The island has plenty of wood; they went to work then, and made a ladder or shrouds of the bark of the lind tree (which is very tough and strong) so long till they could with it reach the water below; one end of this bark ladder they tied fast to a great tree that grew at the side of the rock above the fall, and let the other end down to the water. So they went down along their new-invented stairs, and when they came to the bottom in the middle of the fall they rested a little; and as the water next below the fall is not rapid, as before mentioned, they threw themselves out into it, thinking to swim on shore. We have said before, that one part of the fall is on one side of the island, the other on the other side. Hence it is, that the waters of the two cataracts running against each other, turn back against the rock that is just under the island. Therefore, hardly had the Indians begun to swim, before the waves of the eddy threw them back with violence against the rock from whence they came. They tried it several times, but at last grew weary; and by being often thrown against the rock they were much bruised, and the skin torn off their bodies in many places. So they were obliged to climb up stairs again to the island, not knowing what to do. After some time they perceived Indians on the shore, to whom they cried out. These saw and pitied them, but gave them little hope or help: yet they made haste down to the fort, and told the commandant where two of their brothers were. He persuaded them to try all possible means of relieving the two poor Indians; and it was done in the following manner:

The water that runs on the east side of this island is shallow, especially a little above the island towards the eastern shore. The commandant caused poles to be made and pointed with iron; two Indians took upon them to walk to this island by the help of these poles, to save the other poor creatures, or perish themselves. They took leave of all their friends, as if they were going to death. Each had two such poles in his hands, to set to the bottom of the stream, to keep them steady: and in this manner reached the island: and having given poles to the two poor Indians there, they all returned safely to the main land. These two Indians (who in the above-mentioned manner were first brought to this island) were nine days on the island, and almost ready to starve to death. Now since the road to this island has been found, the Indians go there often to kill deer, which have tried to cross the river above the fall, and are driven upon it by the stream. On the west side of this island are some small islands or rocks, of no consequence. The east side of the river is almost perpendicular, the west side more sloping. In former times, a part of the rock at the fall which is on the west side of the island, hung over in such a manner, that the water which fell perpendicularly from it, left a vacancy below, so that people could go under between the rock and the water; but the prominent part some years since broke off and fell down. The breadth of the fall, as it runs in a semicircle, is reckoned to be about 300 feet. The island is in the middle of the fall, and from it the water on each side is almost the same breadth; the breadth of the island at its lower end is about 100 feet. Below the fall, in the holes of the rocks, are great plenty of eels, which the Indians and French catch with their hands without any other means. Every day when the sun shines, you see here from ten o'clock in the morning to two in the afternoon, below the fall, and under you, where you stand at the side of the fall, a glorious rainbow, and sometimes two, one within the other. The more vapours, the brighter and clearer is the rainbow. When the wind carries the vapours from that place, the rainbow is gone, but appears again as soon as new vapours come. From the fall to the landing above it, where the canoes from Lake Erie put ashore (or from the fall to the upper end of the carrying place), is half a mile. Lower the canoes dare not come, lest they should be obliged to try the fate of the two Indians, and perhaps with less success. They have often found below the fall pieces of human bodies, perhaps drunken Indians, that have unhappily come down to the fall. The French say, that they have often thrown whole great trees into the water above, to see them tumble down the fall: they went down with surprising swiftness, but could never be seen afterwards; whence it was thought there was a bottomless deep or abyss just under the fall. The rock of the fall consists of a gray limestone. For an interesting account of this celebrated fall, the reader is referred to Volney's or Hall's Travels in America. Niagara.

Having mentioned the *Six Nations* which live on the banks of the Niagara, we shall here add a few particulars relative to those nations which, as they seem not to be well understood even in America, are probably still less known in Europe. The information which we have to give was communicated to the Royal Society of London by Mr Richard M'Causland surgeon to the 8th regiment of foot, who, writing from the best authority, informs us, that each nation is divided into three tribes, of which the principal are called the *turtle tribe*, the *wolf tribe*, and the *bear tribe*.

Each tribe has two, three, or more chiefs, called *sachems;* and this distinction is always hereditary in the family, but descends along the female line: for instance, if a chief dies, one of his sister's sons, or one of his own brothers, will be appointed to succeed him. Among these no preference is given to proximity or primogeniture; but the sachem, during his lifetime, pitches upon one whom he supposes to have more abilities than the rest; and in this choice he frequently, though not always, consults the principal men of the tribe. If the successor happens to be a child, the offices of the post are performed by some

of

Niagara. of his friends until he is of sufficient age to act himself.

Each of these posts of sachem has a name which is peculiar to it, and which never changes, as it is always adopted by the successor: nor does the order of precedency of each of these names or titles ever vary. Nevertheless, any sachem, by abilities and activity, may acquire greater power and influence in the nation than those who rank before him in point of precedency; but this is merely temporary, and dies with him.

Each tribe has one or two chief warriors; which dignity is also hereditary, and has a peculiar name attached to it.

These are the only titles of distinction which are fixed and permanent in the nation; for although any Indian may by superior talents, either as a counsellor or as a warrior, acquire influence in the nation, yet it is not in his power to transmit this to his family.

The Indians have also their great women as well as their great men, to whose opinions they pay great deference: and this distinction is also hereditary in families. They do not sit in council with the sachems, but have separate ones of their own.—When war is declared, the sachems and great women generally give up the management of public affairs into the hands of the warriors. It may however so happen, that a sachem may at the same time be also a chief warrior.

Friendship seems to have been instituted with a view towards strengthening the union between the several nations of the confederacy; and hence friends are called the *sinews of the Six Nations*. An Indian has therefore generally one or more friends in each nation. Besides the attachment which subsists during the lifetime of the two friends, whenever one of them happens to be killed, it is incumbent on the survivor to replace him, by presenting to his family either a scalp, a prisoner, or a belt consisting of some thousands of wampum; and this ceremony is performed by every friend of the deceased.

The purpose and foundation of war parties, therefore, is in general to procure a prisoner or scalp to replace the friend or relation of the Indian who is the head of the party. An Indian who wishes to replace a friend or relation presents a belt to his acquaintance; and as many as choose to follow him accept this belt, and become his party. After this, it is of no consequence whether he goes on the expedition or remains at home (as it often happens that he is a child;) he is still considered as the head of the party. The belt he presented to his party is returned fixed to the scalp or prisoner, and passes along with them to the friends of the person he replaces. Hence it happens, that a war party, returning with more scalps or prisoners than the original intention of the party required, will often give one of these supernumerary scalps or prisoners to another war party whom they meet going out; upon which this party, having fulfilled the purpose of their expedition, will sometimes return without going to war. Niagara, Nicæa.

NICÆA, in *Ancient Geography*, the metropolis of Bithynia; situated on the lake Ascanius, in a large and fertile plain; in compass 16 stadia: first built by Antigonus, the son of Philip, and thence called *Antigonea;* afterwards completed by Lysimachus, who called it *Nicæa*, after his consort the daughter of Antipater. According to Stephanus, it was originally a colony of the Bottiæi, a people of Thrace, and called *Ancore;* and afterwards called *Nicæa*. Now *Nice* in Asia the Less*. Famous for the first general council.—A second *Nicæa*, (Diodorus Siculus), of Corsica.—A third, of the Hither India, (Arrian); situated on the west side of the Hydaspes, opposite to Bucephale, on the east side.—A fourth *Nicæa*, a town of Liguria, at the Maritime Alps, on the east side of the river Paulon, near its mouth, which runs between the Varus and Nicæa, (Mela). A colony of the Massilians, (Stephanus); the last town of Italy to the west. Now *Nizza* or *Nice*, capital of the county of that name, on the Mediterranean.—A fifth, of Locris, (Strabo); a town near Thermopylæ; one of the keys of that pass. It stood on the Sinus Maliacus. * See *Nice*.

END OF THE FOURTEENTH VOLUME.

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